

74-4  
HSL No. 74-4  
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THIS ISSUE CONTAINS:

HS-013 778 - HS-013 832  
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U.S. Department of  
Transportation

National Highway  
Traffic Safety  
Administration



*Shelve in Stacks S.B.T.*

# Highway Safety Literature

... A SEMI-MONTHLY ABSTRACT JOURNAL

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Documents listed in **Highway Safety Literature** are **not** available from the National Highway Traffic Safety Administration. They must be ordered from the sources indicated on the citations, usually at cost. Ordering information for each of the sources is listed below.

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**Reference copy only:** Consult your librarian.

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9 [REDACTED]  
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A document containing several articles is announced as complete volume under an HS number referring to it as a whole. Entries for individual articles are listed under their own HS numbers.

## SAMPLE ENTRIES

**JOURNAL ENTRY**

**Title of Document** { **SYNTHESIS OF CASE LAW JURISPRUDENCE RELATING TO WET-WEATHER HIGHWAY CONDITIONS**

**Journal Citation** → Highway Research Record n 376 p29-36 (1971)

**Author(s)** → D. C. Oliver 1971

Sponsored by Highway Res. Board Steering Com. for Workshop on Anti-Skid Program Management and presented at the workshop.

**Search Terms** { Descriptors: \*Liability, \*Negligence, \*Accident responsibility, \*Legal responsibility, \*Wet road conditions, \*Court decisions, \*State government, \*Skidding accidents, \*Warning signs, \*Highway maintenance, \*Litigation, \*Icy road conditions.

**Abstract** { The extant case law on legal liability for accidents occurring on icy and wet highways has established three central areas and one subarea in the jurisprudence of maintenance liability. These areas are compliance with general duties in order to escape liability; damages resulting from noncompliance (negligence); contributory negligence as a bar to recovery; and advisory signing as a technique in meeting general duties. Court decisions covering these four areas are presented.

**NHTSA Accession Number** → HS-012 289

\*Subject heading in Subject Index

**CONTRACT REPORT**

**EQUIPMENT AND PROCEDURES FOR MEASURING GLARE FOR MOTOR VEHICLES. FINAL REPORT**

**Corporate author** → Teledyne Brown Engineering

**Availability** → N. E. Chatterton J. D. Hayes E. W. George 1972 102p

Contract DOT-HS-089-1-139

NTIS

Descriptors: \*Glare, \*Glare reduction, \*Visual perception, \*Photometers, \*Luminance, \*Hydraulic equipment, \*Central vision, \*Field of view, \*Backgrounds, \*Contrast, \*Light conditions, \*Brightness, \*Test facilities, \*Test equipment, \*Vehicle safety standards, \*Simulators, \*Light, \*Reflectance, \*Measuring instruments.

A procedure and description of equipment for measuring glare from a driver's own vehicle are presented. The procedures are based on a disability glare theory as applied to foveal vision. Two pieces of apparatus were constructed to provide the measurement capability. One of them simulates diffuse sky glare and the other simulates direct solar glare. Methods of combining data from these measurements are presented along with scaling laws selected to provide a value for glare as it would be under natural daylight conditions. A standard for allowable glare levels from the vehicle is developed which is independent of the measurement procedure. Test results from a passenger car are presented and compared with this standard. Recommendations for improvements to the apparatus and additional research requirements for improvement to the theory are made.

HS-800 731

\*Subject heading in Subject Index

## 1. ACCIDENTS

### 1B. Injuries

#### EFFECTIVE HIGHWAY BARRIERS

For primary bibliographic entry see Fld. 2D.  
HS-013 814

### 1C. Investigation And Records

#### BIAS IN THE TAD SEVERITY SCALE

North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
L. I. Griffin, 3rd 1973 57p 3refs  
Sponsored in part by the North Carolina Governor's Highway Safety Program.  
Corporate author

Damage severity index, Damage estimation, Judgment, Coding systems, Deformation analysis, Accident analysis, Photographs, Crush distance

The Traffic Accident Data (TAD) Vehicle Damage Scale designates the point of impact by alpha codes and indicates damage severity by numerical codes. It is a seven-point scale with three anchor points, represented by photographs at levels one, four, and six. Experiments were conducted to determine whether the TAD Scale is biased because photographs are not provided for levels one, three, five, and seven. Some groups of subjects were asked to judge the damage severity of crushed beer cans and other groups of subjects judged the density of random patterns of X's on the basis of seven-point scales employing three of seven photographic levels. Comparisons were made to determine differences in judgment. Subjects using the scale with seven photographic levels were less likely to record damage as less severe, and more accurate.  
HS-013 812

**MOTOR CARRIER ACCIDENT INVESTIGATION.**  
**WILLIAM VOLKER AND COMPANY AND**  
**KERRVILLE BUS COMPANY. ACCIDENT--MARCH 7,**  
**1973--BAKERSFIELD, TEXAS. NINE KILLED**  
17P Rept. No. 73-1  
Corporate author

Accident case reports, Accident investigation, Truck accidents, Bus accidents, Driver intoxication, Accident caused fires, Centerline crossover collisions, Tractor semitrailers, Bridge parapets, Vehicle fixed object collisions, Accident location, Jackknifing, Driver characteristics, Vehicle characteristics, Accident causes, Blood alcohol levels, Bakersfield (Texas)

At 9:10 p.m. a westbound tractor semitrailer collided with a parapet of the Tunis Creek Bridge and traveled along the bridge striking the curb and railing. The truck then jackknifed and struck a bus traveling in the opposite lane of traffic. Both vehicles were engulfed in flames and totally destroyed. Nine fatalities, 20 injuries, and —90,000 property damage resulted. The probable cause of the accident was the disorientation of the intoxicated truck driver, who had a blood alcohol level of .185%. The co-driver of the truck was also intoxicated with a blood alcohol level of .21%.  
HS-013 820

#### **MOTOR CARRIER ACCIDENT INVESTIGATION.** **MICKOW CORPORATION ACCIDENT--APRIL 3,** **1973--NEAR DAVENPORT, IOWA**

9P Rept. No. 73-2  
Corporate author

Accident case reports, Accident investigation, Ran off road accidents, Single vehicle accidents, Vehicle fixed object collisions, Truck accidents, Drug caused accidents, Tractor semitrailers, Amphetamines, Accident location, Time of accidents, Driver records, Ejection, Driver fatigue caused accidents, Drug effects, Highway characteristics, Driver mental fitness, Davenport

At 2:27 a.m. at the Stockton-New Liberty, Iowa interchange on I-80 a tractor semitrailer ran off the right side of the road, climbed an embankment, and collided with the interchange overpass. The truck driver and an unauthorized passenger were ejected from the cab and killed. Property damage in the amount of —10,000 occurred. The accident was caused by the disorientation of the truckdriver, who was under the influence of amphetamines.  
HS-013 825

#### **CAN OUR SCHOOL BUSES BE MADE SAFER?**

For primary bibliographic entry see Fld. 5B.  
HS-013 827

#### **OVEREMPHASIS ON ALCOHOL MAY BE COSTING LIVES. REV. ED.**

Rutgers--The State Univ., New Brunswick, N. J., Center of Alcohol Studies  
For primary bibliographic entry see Fld. 3A.  
HS-013 829

## 2. HIGHWAY SAFETY

#### **TRAFFIC ACCIDENT FACTS 1972, CITY OF PHILADELPHIA**

38P  
Corporate author

Philadelphia, Accident statistics, Accident rates, Traffic accidents, Accident analysis, Fatality rates, Injury rates, Accident types, Age factor in accidents, Sex factor in accidents, Accident costs, Accident risks, Accident prevention, Time of accidents, Pedestrian accidents, Accident location, Light conditions

The number of reported motor vehicle accidents in Philadelphia jumped from 58,411 in 1971 to 62,882 in 1972, an increase of 7%. Motor vehicle fatalities increased to 211, a 4% increase over 1971. However, the increase in fatalities in the pedestrian area was drastically higher, 127 versus 102. Philadelphia's traffic accident experience in 1972 was in line with the national trend. Driver involvement, fatality and injury rates, accident costs, pedestrian accidents, accident risks, and traffic safety indoctrination and accident prevention activities are discussed. A comparison of 1972 and 1971 accident statistics is presented. Detailed tables and graphs of accident statistics supplement the text.  
HS-013 781

#### **ACCIDENT FACTS. 1973 ED.** 100P

## Field 1—ACCIDENTS

HSL 74, No. 3r

### Group 2—HIGHWAY SAFETY

Corporate author —2.80

Accident statistics, Accident analysis, Home accidents, Industrial accidents, Farm accidents, School accidents, Traffic accidents, Injury rates, Accident costs, Accident causes, Age factor in accidents, Sex factor in accidents, Fatality rates, Urban accidents, Rural accidents, Accident types, Time of accidents, Month, Day of week, Vehicle mileage, Drinking drivers, Drug caused accidents, Pedestrian accidents, School bus accidents, Driver residence, Railroad accidents, Marine accidents, Aircraft accidents

Detailed accident, injury, and fatality statistics are presented for industrial, motor vehicle, home, farm, and school accidents which occurred in 1972. Statistics are also given for public accidents which include aircraft, marine, railroad, bicycle, snowmobile, and drowning accidents and accidents caused by falls, firearms, and fires.

HS-013 799

7P

Corporate author

Young adult drivers, Drinking drivers, Driver age, Adolescent drivers, Alcohol laws, Alcohol usage, Accident rates, Roadside hazards, Michigan, Accident severity, Injury rates, Fatality rates

With state after state lowering the legal age for consuming alcohol to 18, safety authorities view the youthful drinking driver as a deadly new hazard to compound the traffic accident crisis that already costs the nation thousands of lives, millions of injuries, and billions of dollars annually. Research returns from Michigan, which lowered its drinking age to 18 on January 1, 1972, disclosed that in the first nine months the newly enfranchised drinking drivers: increased by 120% their number of alcohol-related accidents; increased by 66% their number of fatal accidents; increased by 114% their number of injury accidents; and increased by 127% their number of property damage accidents. The problem of increasing roadside hazards is also discussed. The development of public education programs for the young driver, stressing the consequences of drinking and driving; stronger enforcement of drunk driving laws; and removal of roadside hazards are recommended.

HS-013 824

## 2. HIGHWAY SAFETY

### 2D. Design And Construction

#### OPTIMUM POLICY FOR WARRANTS FOR AND DESIGN OF GUARDRAILS

Accident Analysis and Prevention v5 p193-202 (1973)  
T. Edamura 1973 4refs  
See serial citation

Guardrail design, Barrier warrants, Injury prevention, Accident rates, Roadside hazards, Benefit cost analysis, Maintenance costs, Mathematical analysis

An optimum policy for the warrants for and the design of guardrails based on benefit maximizing criteria is presented. It is shown that the strength, the number of classes of standards, and the location of guardrails should be determined simultaneously with due consideration for the nationwide distribution of roadside dangers and the impact of colliding vehicles. Dynamic programming is used for optimization.

HS-013 813

#### EFFECTIVE HIGHWAY BARRIERS

Accident Analysis and Prevention v5 p203-14 (1973)  
J. G. Viner, F. J. Tamanini 1973 39refs  
See serial citation

Guardrail design, Bridge parapet design, Impact attenuators, Median barrier design, Safety design, Design standards, Injury prevention, Fatality prevention, Gores

Bridge rail and guardrail design has evolved over the years in an attempt to meet the needs of the times. The standards to which guardrails and bridge rails must perform have been made more demanding by the slow but steady increase in the average operating speed of vehicles in recent years. Researchers have been and are now responding to the needs for traffic railings with improved performance characteristics, and highway authorities have quickly put to practice the results of this research. Research efforts over the last several years have led to the development of a first generation of impact attenuators for use at roadside hazards in the gore area. The life-saving benefits of such devices have been verified through research and experimental construction. Recent research findings in the United States in the area of the development of bridge railings, guardrails, and impact attenuators are discussed.

HS-013 814

#### CRASH BARRIER RESEARCH IN THE NETHERLANDS

Accident Analysis and Prevention v5 p215-22 (1973)  
F. C. Flury, H. G. Paar 1973 4refs  
See serial citation

Energy absorbing barriers, Median barrier design, Deflection, Guardrail posts, Mathematical models, Bridge parapet design, Netherlands

A series of barriers of basically the same design but with varying degrees of resistance to lateral deflection has been adopted as the standard for the Netherlands' national road network. A barrier should fulfill a set of requirements: during the crash phase the space occupation by the colliding vehicle must be limited to the area bounded by the road edge and the boundary of the hazard area; the longitudinal speed loss must be limited; the lateral component of the re-entrance speed should be minimized; the accelerations of the colliding vehicle should not exceed a 5 g level; and the barrier should still be operational after a collision. A beam consisting of two W-shaped rails and spacers every 1.33 meters was developed with a possible addition of diagonal bars and a set of relatively weak posts, for soft soil and for bridges. A mathematical model is developed for simulating barrier collisions.

HS-013 815

#### TOWARDS A RATIONALE FOR WARRANTS WITH AN APPLICATION TO MEDIAN BARRIERS

For primary bibliographic entry see Fld. 4C.  
HS-013 816

#### THE FITCH INERTIAL BARRIER--ITS DESIGN AND PERFORMANCE

Accident Analysis and Prevention v5 p231-41 (1973)  
R. Jain, W. J. Kudzia 1973 5refs  
See serial citation

Energy absorbing barriers, Barrier design, Highway costs, Maintenance costs, Highway improvements, Fatality prevention, Safety device effectiveness, Connecticut, Accident rates, Injury prevention

The Fitch Inertial Barrier System, an energy absorbing crash barrier, is described. To date, Connecticut has installed the Fitch Barrier at 35 locations throughout the state. The original 15 locations required no site preparation and were installed by the State Maintenance Forces. Installation costs for these locations ranged from —1,550 to —2,925, including labor. Maintenance costs for hits recorded to date have ranged from —320 to —1,365. Twenty new installations have been recently completed, all requiring considerable site preparation. Installation costs for these locations averaged —1,710 and site preparation costs averaged about —5,200. Barrier performance in Connecticut has been good. Data collected thus far shows that the lives of eight to 10 drivers have been saved. Information gathered from unreported accidents indicates that the barriers have probably saved many more.

HS-013 817

#### **THE EFFECTIVENESS OF IMPACT ATTENUATORS: TWO CASE STUDIES IN MASSACHUSETTS**

Accident Analysis and Prevention v5 p243-5 (1973)

E. J. Fitzgerald, Jr. 1973

See serial citation

Crash cushions, Barrier design, Accident rates, Safety device effectiveness, Accident investigation, Benefit cost analysis, Massachusetts

An investigation of all collisions experienced over a two year period of two crash cushion modules in Massachusetts revealed a benefit/cost ratio greater than 2.4.

HS-013 818

#### **PHYSICAL AND PSYCHOLOGICAL ASPECTS OF CRASH BARRIERS**

Accident and Analysis and Prevention v5 p247-51 (1973)

R. Naatanen, H. Summala 1973 9refs

Supported by Association of the Finnish Traffic Insurance Companies and Humanistic Council of the Finnish Academy.

See serial citation

Median barriers, Driver behavior, Psychological factors, Accident prevention, Accident rates

The psychological effects of crash barriers on driver behavior are discussed. The anticipated or already demonstrated behavioral effects of crash barriers favorable to traffic safety are divided into three subclasses: an increase in the negative feedback to certain unsafe forms and aspects of traffic behavior; an increase in the driver's subjective risk; and the introduction of an aid for the driver in choosing his driving lines. Evidence supporting these behavioral effects is briefly reviewed. A possible extension of the use of the crash barrier—specifically its installation along the mid-line of broad two lane roads—is proposed for further investigation.

HS-013 819

#### **THE BIKEWAY PLAN**

73P 10REFS

Denver Planning Office, Rm. 300, 1445 Cleveland Place, Denver, Colorado 80202

Bikeway planning, Denver, Bicycle usage, Origin and destination studies, Travel patterns, Surveys, Bicycle safety, Bicycle accidents, Bicycle rider age, Transportation system costs, Buses, Travel time, Routes, Trip frequencies, Legal factors, Maps

This study was conducted to assess bicycle demand for routes; to develop a bike route plan; to estimate costs; and to develop implementation phases. Origin and destination questionnaires were distributed to current bicycle commuters. Downtown employees and students were surveyed; 23 intersections were monitored for bicycle travel; and interviews were conducted at four city parks to determine distance traveled to the park. The study showed a significant number of bicycle commuters and a still larger percentage of potential commuters if planned bikeways were available. A total system of 164 miles of planned bicycle routes is proposed. Tables (listed in the Appendix), describing the routes, mileage, estimated costs, traffic volumes, speed limits, and unusual situations associated with development of each bicycle route, and maps illustrating the routes are included. Types of bikeways, bicycle safety, legal factors, and a bicycle-bus system are also discussed.

HS-013 823

#### **7P**

Corporate author

Young adult drivers, Drinking drivers, Driver age, Adolescent drivers, Alcohol laws, Alcohol usage, Accident rates, Roadside hazards, Michigan, Accident severity, Injury rates, Fatality rates

With state after state lowering the legal age for consuming alcohol to 18, safety authorities view the youthful drinking driver as a deadly new hazard to compound the traffic accident crisis that already costs the nation thousands of lives, millions of injuries, and billions of dollars annually. Research returns from Michigan, which lowered its drinking age to 18 on January 1, 1972, disclosed that in the first nine months the newly enfranchised drinking drivers: increased by 120% their number of alcohol-related accidents; increased by 66% their number of fatal accidents; increased by 114% their number of injury accidents; and increased by 127% their number of property damage accidents. The problem of increasing roadside hazards is also discussed. The development of public education programs for the young driver, stressing the consequences of drinking and driving; stronger enforcement of drunk driving laws; and removal of roadside hazards are recommended.

HS-013 824

#### **MEASUREMENT AND PREDICTION OF THE DYNAMIC TIRE FORCES OF A PASSENGER VEHICLE ON A HIGHWAY. FINAL REPORT**

Purdue Univ., Lafayette, Ind.

For primary bibliographic entry see Fld. 5V.

HS-013 832

#### **THE EFFECT OF PAVEMENT ROUGHNESS ON SAFE VEHICLE HANDLING CHARACTERISTICS. FINAL REPORT**

Purdue Univ., Lafayette, Ind.

B. E. Quinn, S. E. Hildebrand 1972 124p 21refs Rept. No.

FHWA-RD-72-25, PB-218 988

Contract DOT-FH-11-7797

NTIS

## Group 2D—Design And Construction

Pavement surface texture, Vehicle handling, Tire road contact forces, Tire side forces, Steering, Computerized simulation, Sideslip, Chi square test, Histograms, Tire slip motion, Lateral force, Camber, Coefficient of friction, Vehicle center of gravity, Lane changing, Neutral steer, Turning, Understeer, Oversteer, Vehicle control, Weight transfer, Mathematical models, Mathematical analysis

A simple mathematical model is selected to represent the vehicle, and pavement roughness is introduced in the form of time-varying dynamic tire forces. The path of the vehicle is determined for a step steer angle input for different vehicle parameters and pavement roughness. The steer angle and the sideslip angle are determined for selected paths and vehicle parameters. It is concluded that pavement roughness reduces the forces that are available to control the vehicle.

HS-013 900

## 2I. Traffic Control

## NATIONWIDE PERSONAL TRANSPORTATION STUDY, REPORT 8. HOME-TO-WORK TRIPS AND TRAVEL

Federal Hwy. Administration, Washington, D. C.  
P. V. Svercl, R. H. Asin 1973 104p Rept. No. 8  
Corporate author

Commuting patterns, Trip length, Travel time, Travel modes, Vehicle mileage, Automobile occupancy, Trip purpose, Day of week, Time of day, Driver residence, Age factors, Residential location, Public transportation usage, Automobile usage, Income, Occupation, Population density, Automobile ownership, Parking, Questionnaires

Most workers live in places with the same size population as their place of employment, and 53% live five miles or less from their jobs and arrive in 15 minutes or less. Almost 83% of commuting is done by automobile; almost 80% in single-occupant cars; and almost 90% from Monday through Friday. The automobile is the commuter's predominant travel mode. Automobile users usually commute farther and arrive in less time than public transportation users. The average home-to-work trip is 9.9 miles by all travel modes and 9.4 miles by automobile. Half of all workers have no public transportation available. Commuting accounts for almost one-third of all automobile trips and vehicle mileage. Two-thirds of commuting trips are made between 6:00 and 9:00 a.m., and 3:00 and 6:00 p.m. Approximately 52% of commuting automobile trips are five miles or less and almost three-fourths are 10 miles or less.

HS-013 782

## DRIVER REACTION INFLUENCE ON THE STABILITY OF ROAD TRAFFIC FLOW

International Conference on Vehicle Mechanics (2nd)  
Proceedings, Amsterdam, 1973 p75-88  
Rensselaer Polytechnic Inst., Troy, N. Y.  
P. W. Berry, D. McBrinn 1973 3refs  
In HS-013 800

Computerized simulation, Traffic flow, Simulation models, Car following, Linear systems, Nonlinear systems, Driver reaction time, Acceleration

A digital computer simulation is used to investigate the dynamics of a train of unconnected vehicles. The study is particularly aimed at an understanding of the characteristics of automobile

traffic flow on a major highway. The simulation technique allows full flexibility in investigating a wide range of models, both linear and nonlinear. In particular, the effects of driver delay time, nonlinearities in the driver response to inputs, and limitations on achievable accelerations are investigated. The results obtained demonstrate that large differences, both qualitative and quantitative, exist between the linear models and the more realistic nonlinear models.

HS-013 804

## 3. HUMAN FACTORS

## MANPOWER DEVELOPMENT IN TRAFFIC SAFETY (GUIDELINES FOR ESTABLISHING INTERNSHIP PROGRAMS)

San Diego County Engineer Dept. Calif.  
W. E. Marsden, Jr., R. C. Sanders 1973 27p  
Corporate author

Manpower utilization, Highway safety programs, Safety education, Guidelines, Management, Program evaluation, Financing, Curricula

Although Federal and State highway safety work programs call for manpower development in traffic safety, there is currently no systematic method for determining manpower resource needs and the means for meeting those needs. Traditionally highway safety manpower needs have been filled from three principal sources: law enforcement, traffic engineering, and departments of motor vehicles. Persons assigned highway safety tasks have had to learn the job as they perform it. This report provides general guidelines for highway safety internship programs which will supply the future manpower needs of highway safety with a trained, educated cadre of safety professionals. Suggested course offerings for traffic safety majors at both the Bachelors and Masters levels are included.

HS-013 783

## 3A. Alcohol

## MOTOR CARRIER ACCIDENT INVESTIGATION. WILLIAM VOLKER AND COMPANY AND KERRVILLE BUS COMPANY. ACCIDENT--MARCH 7, 1973--BAKERSFIELD, TEXAS. NINE KILLED 17P Rept. No. 73-1

Corporate author

Accident case reports, Accident investigation, Truck accidents, Bus accidents, Driver intoxication, Accident caused fires, Centerline crossover collisions, Tractor semitrailers, Bridge parapets, Vehicle fixed object collisions, Accident location, Jackknifing, Driver characteristics, Vehicle characteristics, Accident causes, Blood alcohol levels, Bakersfield (Texas)

At 9:10 p.m. a westbound tractor semitrailer collided with a parapet of the Tunis Creek Bridge and traveled along the bridge striking the curb and railing. The truck then jackknifed and struck a bus traveling in the opposite lane of traffic. Both vehicles were engulfed in flames and totally destroyed. Nine fatalities, 20 injuries, and —90,000 property damage resulted. The probable cause of the accident was the disorientation of the intoxicated truck driver, who had a blood alcohol level of .185%. The co-driver of the truck was also intoxicated with a blood alcohol level of .21%.

HS-013 820

7P

Corporate author

Young adult drivers, Drinking drivers, Driver age, Adolescent drivers, Alcohol laws, Alcohol usage, Accident rates, Roadside hazards, Michigan, Accident severity, Injury rates, Fatality rates

With state after state lowering the legal age for consuming alcohol to 18, safety authorities view the youthful drinking driver as a deadly new hazard to compound the traffic accident crisis that already costs the nation thousands of lives, millions of injuries, and billions of dollars annually. Research returns from Michigan, which lowered its drinking age to 18 on January 1, 1972, disclosed that in the first nine months the newly enfranchised drinking drivers: increased by 120% their number of alcohol-related accidents; increased by 66% their number of fatal accidents; increased by 114% their number of injury accidents; and increased by 127% their number of property damage accidents. The problem of increasing roadside hazards is also discussed. The development of public education programs for the young driver, stressing the consequences of drinking and driving; stronger enforcement of drunk driving laws; and removal of roadside hazards are recommended.

HS-013 824

### OVEREMPHASIS ON ALCOHOL MAY BE COSTING LIVES. REV. ED.

Rutgers--The State Univ., New Brunswick, N. J., Center of Alcohol Studies

R. Zylman 1973 14p

Presented at Highway Safety Com. Annual Meeting at the International Assoc. of Chiefs of Police Annual Conference (80th), San Antonio, 23 Sep 1973.

Corporate author

Drinking drivers, Accident causes, Alcohol chemical tests, Driver intoxication, Single vehicle accidents, Multiple vehicle accidents, Age factor in accidents, Drinking pedestrians, Pedestrian intoxication, Accident investigation

If only 60 or 70% of all traffic victims are tested for alcohol, the results show a higher percentage with high blood alcohol levels than would actually be found if all victims could be tested. This is because the victims not tested include children, those involved in accidents in which alcohol is not believed to be a factor, and those who survive a sufficient period of time after the crash so that a blood test would no longer be considered useful. It has been found that those who survive more than six hours tend to be older, tend to die of injuries from which younger persons would recover, tend to have been involved in multiple vehicle crashes, and tend not to have been drinking. Other discrepancies between official and popular belief and results of research on alcohol involvement in traffic accidents are also presented.

HS-013 829

### 3D. Driver Behavior

#### MEASUREMENT AND SUBJECTIVE EVALUATION OF VEHICLE HANDLING

Ford Motor Co., Dearborn, Mich.

For primary bibliographic entry see Fld. 5R.

HS-013 784

#### A SYSTEM APPROACH TO CERTAIN CONTROL PROBLEMS IN VEHICLES WITH AN APPLICATION TO CAR FOLLOWING

International Conference on Vehicle Mechanics (2nd)

Proceedings, Amsterdam, 1973 p3-8

Wayne State Univ., Detroit, Mich.

A. W. Jones 1973 4refs

Abridged version.

In HS-013 800

Man machine systems, Systems engineering, Vehicle control, Mathematical models, Car following

The applicability of the systems engineering method to vehicle control problems is discussed. In order to illustrate the difference between systems engineering models (design oriented models) and science oriented models in automotive control, a systems engineering model for car following is presented. General steps in the development of vehicle control system models are outlined as follows: formulate a driver utility function; from the utility function develop a decision rule of feasible actions derived from attainable information; obtain an explicit expression for the value of the utility function in terms of the information and control restraints imposed by the engineering design; develop an economic model which will associate costs with parameter design improvements; establish cost performance curves for each task performed; and weigh the relative importance of the tasks and obtain an overall optimum for vehicle control.

HS-013 801

#### PHYSICAL AND PSYCHOLOGICAL ASPECTS OF CRASH BARRIERS

For primary bibliographic entry see Fld. 2D.

HS-013 819

#### AN EVALUATION OF THE SAFETY PERFORMANCE OF TRICYCLES AND MINIBIKES

Calspan Corp., Buffalo, N. Y.

For primary bibliographic entry see Fld. 5C.

HS-013 822

#### EFFECTS OF EXPERIENCE OF THE DRIVER ON HEART-RATE, RESPIRATION-RATE, AND SUBSIDIARY REACTION TIME IN A THREE HOURS CONTINUOUS DRIVING TASK

Ergonomics v16 n4 p501-6 (Jul 1973)

H. O. Lisper, H. Laurell, G. Stening 1973 13refs

See serial citation

Heart rate, Respiratory rate, Driver experience, Driver monitoring, Driving task analysis, Driver fatigue, Test volunteers, Driver reaction time, Tracking

From accident statistics a difference was hypothesized between experienced and inexperienced drivers in vulnerability to continuous driving. This difference was used as a basis for a comparison of changes in autonomic measures and reaction time over driving time. The result showed significant effects of experience on both types of measures. Heart rate pointed to experienced and reaction time pointed to inexperienced drivers as being the most vulnerable to continuous driving. This contradiction was solved with reference to statistical data and validation of the reaction time task. Thus in this study reaction time was preferred to the autonomic measures.

HS-013 826

## Group 3D—Driver Behavior

**EFFECTS OF HEAD RESTRICTION ON DRIVERS' EYE MOVEMENTS AND ERRORS IN SIMULATED DANGEROUS SITUATIONS**

North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
S. R. Schroeder, J. A. Allen, Jr., P. G. Ball 1973 28p 8 refs  
Sponsored by North Carolina Governor's Hwy. Safety Office.  
Corporate author

Eye movements, Head movement, Visual behavior, Tracking,  
Driver performance, Driving simulators, Driver errors

In an effort to investigate the effects of restrictive head movement upon eye movements, two groups of 15 student volunteers, one group with head restricted, the other with no head restriction, tracked a segment of the Aetna Training film, Traffic Strategy. Tracking was done by manipulating the controls of an Aetna Drive-Trainer Station. Eye movements were recorded simultaneously. It was found that driving performance is better when drivers are able to move their eyes and head about in an unrestricted manner; restricting the head may alter where a driver looks in the visual environment; and how often individuals shift their fixations is negatively correlated with errors, that is, more eye movements appear to relate to fewer driving errors.

HS-013 831

**3G. Drugs Other Than Alcohol****MOTOR CARRIER ACCIDENT INVESTIGATION. MICKOW CORPORATION ACCIDENT--APRIL 3, 1973--NEAR DAVENPORT, IOWA**  
9P Rept. No. 73-2

Corporate author

Accident case reports, Accident investigation, Ran off road accidents, Single vehicle accidents, Vehicle fixed object collisions, Truck accidents, Drug caused accidents, Tractor semitrailers, Amphetamines, Accident location, Time of accidents, Driver records, Ejection, Driver fatigue caused accidents, Drug effects, Highway characteristics, Driver mental fitness, Davenport

At 2:27 a.m. at the Stockton-New Liberty, Iowa interchange on I-80 a tractor semitrailer ran off the right side of the road, climbed an embankment, and collided with the interchange overpass. The truck driver and an unauthorized passenger were ejected from the cab and killed. Property damage in the amount of —10,000 occurred. The accident was caused by the disorientation of the truckdriver, who was under the influence of amphetamines.

HS-013 825

**3I. Impaired Drivers****VEHICLE DRIVING BY THE DISABLED. LITERATURE REVIEW**

Texas A and M Univ., College Station  
W. A. Hyman, A. M. Mayyasi, C. F. Mann 1972 16p 77refs  
Contract V101(134)  
Corporate author

Handicapped drivers, Reviews, Driver records, Driver licensing, Driver physical fitness, Self help devices, Automobile modification, Safety standards, Driver skills

The presently available adaptive equipment allows a limited group of the disabled to drive. A review of the literature indicates that the accident and violation record of this group is not distinguishable from that of the general population despite the complete lack of standards for the equipment involved and the shortage of knowledge on what level of physical ability is required to operate an automobile. The necessity of determining the needed driving skills and designing quality equipment for the handicapped which will help provide these skills is emphasized. The need to introduce design and safety standards for such equipment in order to protect the disabled driver and the general population is also discussed. It is recommended that research developments in the area of the disabled driver should be closely coupled with developments with respect to the normal driver so that pertinent information and new devices can be readily exchanged.

HS-013 830

**4. OTHER SAFETY-RELATED AREAS****4C. Cost Effectiveness****THE ECONOMICS OF BUMPER DESIGN**

Brigham Young Univ., Provo, Utah  
For primary bibliographic entry see Fld. 5D.  
HS-013 811

**OPTIMUM POLICY FOR WARRANTS FOR AND DESIGN OF GUARDRAILS**

For primary bibliographic entry see Fld. 2D.  
HS-013 813

**TOWARDS A RATIONALE FOR WARRANTS WITH AN APPLICATION TO MEDIAN BARRIERS**

Accident Analysis and Prevention v5 p223-30 (1973)  
J. H. R. Youngman 1973 8refs  
See serial citation

Benefit cost analysis, Barrier warrants, Median barriers, Accident costs, New Zealand, Accident prevention

The techniques of benefit cost analysis are used to develop a method for determining criteria for the introduction of traffic accident countermeasures. The method which, with suitable variations, can be applied to a range of problems is described in general terms and an example is presented of the application of the method to the determination of the need for median barriers on a divided highway. The example provides data which are consistent with the warrant devised for the National Cooperative Highway Research Program in the U. S.

HS-013 816

**THE EFFECTIVENESS OF IMPACT ATTENUATORS: TWO CASE STUDIES IN MASSACHUSETTS**

For primary bibliographic entry see Fld. 2D.  
HS-013 818

**4E. Information Technology****SRCH: A HEADLAMP RESEARCH PROGRAM FOR THE EXTRAPOLATION/INTERPOLATION OF SURFACE VALUES FROM A PREDEFINED GRID**

National Aeronautical Establishment, Ottawa, Ont. (Canada)  
For primary bibliographic entry see Fld. 5J.



HS-013 778

**CONTOUR PLOTTING OF THE HEADLAMP ILLUMINATION MAPS; MAPPING THE ILLUMINATION ON A TARGET PLANE AND AT THE EYE**

National Aeronautical Establishment, Ottawa, Ont. (Canada)  
For primary bibliographic entry see Fld. 5J.  
HS-013 779

**DETERMINATION OF MODAL PROPERTIES OF AUTOMOTIVE BODIES AND FRAMES USING TRANSIENT TESTING TECHNIQUES**

Structural Dynamics Res. Corp., Cincinnati, Ohio  
For primary bibliographic entry see Fld. 5D.  
HS-013 785

**HYBRID COMPUTER SIMULATION STUDIES OF VEHICLE HANDLING**

Bendix Corp., Southfield, Mich.; Bendix Res. Labs., Southfield, Mich.  
For primary bibliographic entry see Fld. 5A.  
HS-013 807

**4G. Mathematical Sciences**

**ANTI-SKID BRAKING OF A TRACTOR-SEMITRAILER TRUCK**

For primary bibliographic entry see Fld. 5A.  
HS-013 780

**INTERNATIONAL CONFERENCE ON VEHICLE MECHANICS (2ND) PROCEEDINGS, PARIS, SEPTEMBER 6-9, 1971**

Paris Univ. (France)  
For primary bibliographic entry see Fld. 5D.  
HS-013 800

**A SYSTEM APPROACH TO CERTAIN CONTROL PROBLEMS IN VEHICLES WITH AN APPLICATION TO CAR FOLLOWING**

Wayne State Univ., Detroit, Mich.  
For primary bibliographic entry see Fld. 3D.  
HS-013 801

**DRIVER REACTION INFLUENCE ON THE STABILITY OF ROAD TRAFFIC FLOW**

Rensselaer Polytechnic Inst., Troy, N. Y.  
For primary bibliographic entry see Fld. 2I.  
HS-013 804

**RIDE COMFORT AS INFLUENCED BY ASYMMETRIC SHOCK ABSORBER CHARACTERISTICS**

Wayne State Univ., Detroit, Mich.  
For primary bibliographic entry see Fld. 5R.  
HS-013 805

**A SIX DEGREE OF FREEDOM MODEL OF A CAR**

Cranfield Inst. of Tech., Beds. (England)  
For primary bibliographic entry see Fld. 5R.  
HS-013 806

**AERODYNAMIC AND ROLLING RESISTANCES OF VEHICLES AS OBTAINED FROM COAST-DOWN EXPERIMENTS**

Illinois Univ., Urbana  
For primary bibliographic entry see Fld. 5D.  
HS-013 808

**CORRECTION FOR THE EFFECT OF AMBIENT CONDITIONS ON VEHICLE ACCELERATIVE PERFORMANCE**

Loughborough Univ. of Technology, Leics. (England)  
For primary bibliographic entry see Fld. 5D.  
HS-013 809

**OPTIMUM POLICY FOR WARRANTS FOR AND DESIGN OF GUARDRAILS**

For primary bibliographic entry see Fld. 2D.  
HS-013 813

**A COMPUTER BASED MATHEMATICAL METHOD FOR PREDICTING THE DIRECTIONAL RESPONSE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 2 TECHNICAL REPORT. MOTOR TRUCK BRAKING AND HANDLING PERFORMANCE STUDY**

Michigan Univ., Ann Arbor, Hwy. Safety Res. Inst.  
For primary bibliographic entry see Fld. 5R.  
HS-013 821

**AN EVALUATION OF THE SAFETY PERFORMANCE OF TRICYCLES AND MINIBIKES**

Calspan Corp., Buffalo, N. Y.  
For primary bibliographic entry see Fld. 5C.  
HS-013 822

**MEASUREMENT AND PREDICTION OF THE DYNAMIC TIRE FORCES OF A PASSENGER VEHICLE ON A HIGHWAY. FINAL REPORT**

Purdue Univ., Lafayette, Ind.  
For primary bibliographic entry see Fld. 5V.  
HS-013 832

**THE EFFECT OF PAVEMENT ROUGHNESS ON SAFE VEHICLE HANDLING CHARACTERISTICS. FINAL REPORT**

Purdue Univ., Lafayette, Ind.  
For primary bibliographic entry see Fld. 2D.  
HS-013 900

**4H. Transportation Systems**

**THE BIKEWAY PLAN**

**73P 10REFS**

Denver Planning Office, Rm. 300, 1445 Cleveland Place, Denver, Colorado 80202

Bikeway planning, Denver, Bicycle usage, Origin and destination studies, Travel patterns, Surveys, Bicycle safety, Bicycle accidents, Bicycle rider age, Transportation system costs, Buses, Travel time, Routes, Trip frequencies, Legal factors, Maps

This study was conducted to assess bicycle demand for routes; to develop a bike route plan; to estimate costs; and to develop

## Field 4—OTHER SAFETY-RELATED AREAS

HSL 74, No. 3r

### Group 4H—Transportation Systems

implementation phases. Origin and destination questionnaires were distributed to current bicycle commuters. Downtown employees and students were surveyed; 23 intersections were monitored for bicycle travel; and interviews were conducted at four city parks to determine distance traveled to the park. The study showed a significant number of bicycle commuters and a still larger percentage of potential commuters if planned bikeways were available. A total system of 164 miles of planned bicycle routes is proposed. Tables (listed in the Appendix), describing the routes, mileage, estimated costs, traffic volumes, speed limits, and unusual situations associated with development of each bicycle route, and maps illustrating the routes are included. Types of bikeways, bicycle safety, legal factors, and a bicycle-bus system are also discussed.

HS-013 823

#### TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN BALTIMORE, MARYLAND. FINAL REPORT

240P REFS Rept. No. APTD-1443

Contract EPA-68-02-0041

Report for 14 Aug 1972-15 Dec 1972.

Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Emission control, Transportation planning, Air quality standards, Baltimore, Vehicle air pollution, Forecasting, Air pollution measurement, Air pollution emission factors, Vehicle mileage, Carbon monoxide, Oxidizers, Traffic density, Vehicle age, Retrofitting, Vehicle inspection, Vehicle maintenance, Hydrocarbons, Traffic flow, Traffic control, Public transportation, Car pools, Transportation regulation, Parking prohibitions, Staggered work times, Fuel taxation, Fares, Central business districts, Economic factors, Political factors, Legal factors, Bus lanes, Sociological factors

Methods of controlling carbon monoxide and oxidant emissions to meet 1977 air quality standards in Baltimore are presented. The contribution of vehicle miles of travel to air pollution is emphasized. The effectiveness of suggested transportation controls, including retrofitting, vehicle inspection and maintenance, gaseous fuel conversion, traffic flow improvements, transit service improvements, car pools, parking prohibitions, staggered work times, and increased fuel taxes, is evaluated. The air quality impact of these transportation controls is estimated and surveillance methods and obstacles facing implementation of the suggested controls are outlined.

HS-013 843

#### EVALUATING TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN MAJOR METROPOLITAN AREAS

365P 151REFS Rept. No. APTD-1364

Contract EPA-68-02-0048

In cooperation with TRW, Inc.

Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Emission control, Transportation planning, Vehicle air pollution, Air quality standards, Urban areas, Carbon monoxide, Air pollution control costs, Vehicle inspection, Vehicle maintenance, Retrofitting, Exhaust emission measurement, Fuel systems, Denver, Natural gas, Liquefied petroleum gases, Automobile modification, Public transportation costs, Traffic flow, Traffic management, Traffic engineering, Bypasses, Belt

highways, Public transportation, Transportation regulation, Traffic bans, Chicago, Parking regulations, Staggered work times, Federal role, State action, Political factors, Legal factors, Economic factors, District of Columbia, New York (City), Los Angeles, San Francisco

Transportation controls which could conceivably reduce motor vehicle emissions in the next few years are described and evaluated. Priority was given to those transportation controls capable of being introduced by 1977 to reduce carbon monoxide emissions from light duty motor vehicles. The study concentrated on large metropolitan areas, with specific reference to Chicago, Denver, Los Angeles, New York City, San Francisco, and Washington, D. C. Transportation controls discussed include inspection, maintenance, and retrofit; gaseous fuel systems; traffic flow techniques; bypassing through traffic; improvements in public transportation; motor vehicle restraints; and work schedule changes. An analysis of the air pollution control potential of each control, including an estimate of the maximum feasible emission reductions which would be possible, and a discussion of institutional feasibility, including probable costs, are presented.

HS-013 846

## 5. VEHICLE SAFETY

### 5A. Brake Systems

#### ANTI-SKID BRAKING OF A TRACTOR-SEMITRAILER TRUCK

Vehicle System Dynamics v2 n2 p61-91 (Jun 1973)

A. I. Krauter 1973 15refs

See serial citation

Antiskid brakes, Tractor semitrailers, Braking, Truck handling, Computerized simulation, Simulation models, Cornering, Degrees of freedom, Vehicle characteristics, Steering, Lateral force, Truck brakes, Yaw, Wheel locking, Wheel slip, Axle brakes, Mathematical analysis

A study of antiskid braking and the effects of such braking on the handling behavior and braking performance of a tractor-semitrailer has been performed. The truck, represented by a 14 degrees of freedom digital computer model, was in a cornering maneuver that involved braking and driver steering. Conventional braking or one of three types of antiskid braking was used in the maneuver. The results show that the effects of antiskid braking on the handling behavior and braking performance of the truck are beneficial. The behavior of the wheels and the handling behavior and braking performance of the truck depend on the type of antiskid braking used. The handling behavior and braking performance produced by axle antiskid braking were similar to those produced by individual wheel braking. The handling behavior and braking performance produced by axle-worst wheel braking were superior to those produced by axle-best wheel braking.

HS-013 780

#### THE MATHER JACKKNIFE CONTROL UNIT

Mather Co., Toledo, Ohio

For primary bibliographic entry see Fld. 5T.

HS-013 795

# HYBRID COMPUTER SIMULATION STUDIES OF VEHICLE HANDLING

International Conference on Vehicle Mechanics (2nd)  
 Proceedings, Amsterdam, 1973 p126-45  
 Bendix Corp., Southfield, Mich.; Bendix Res. Labs., Southfield, Mich.  
 G. B. Hickner, J. G. Elliot 1973 9refs  
 In HS-013 800

Antiskid brakes, Vehicle handling, Computerized simulation, Vehicle dynamics, Braking, Steering, Mathematical models, Brake performance, Computerized safety research techniques, Brake system design, Braking forces, Hybrid computers, Brake tests, Antilocking devices, Wheel locking, Flow charts, Stopping distance, Performance characteristics, Pressure time histories, Vehicle control, Coefficient of friction, Vehicle road interface, Cornering

A hybrid computerized simulation was developed and utilized to study the dynamic response of vehicles during combined braking and steering. The simulation was also used to evaluate standard, rear wheel adaptive, and four wheel adaptive braking systems in straight line braking on split coefficient of friction surfaces and in braking in a turn. Study results indicate that standard brakes cannot provide lateral control during an emergency straight line braking maneuver. With the rear wheel adaptive braking, lateral control can be maintained if the steering wheel is operated, providing that the small amount of side force remaining when the front wheels lock is sufficient to keep the front wheels from drifting side-ways until both are on the high coefficient surface. Lateral control is easily maintained with four wheel adaptive braking and only with four wheel adaptive braking can a car be controlled along the desired path during emergency braking in a turn.  
 HS-013 807

# A COMPUTER BASED MATHEMATICAL METHOD FOR PREDICTING THE DIRECTIONAL RESPONSE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 2 TECHNICAL REPORT. MOTOR TRUCK BRAKING AND HANDLING PERFORMANCE STUDY

Michigan Univ., Ann Arbor, Hwy. Safety Res. Inst.  
 For primary bibliographic entry see Fld. 5R.  
 HS-013 821

## 5B. Buses, School Buses, And Multipurpose Passenger Vehicles

### MOTOR CARRIER ACCIDENT INVESTIGATION. WILLIAM VOLKER AND COMPANY AND KERRVILLE BUS COMPANY. ACCIDENT--MARCH 7, 1973--BAKERSFIELD, TEXAS. NINE KILLED 17P Rept. No. 73-1

Corporate author

Accident case reports, Accident investigation, Truck accidents, Bus accidents, Driver intoxication, Accident caused fires, Centerline crossover collisions, Tractor semitrailers, Bridge parapets, Vehicle fixed object collisions, Accident location, Jackknifing, Driver characteristics, Vehicle characteristics, Accident causes, Blood alcohol levels, Bakersfield (Texas)

At 9:10 p.m. a westbound tractor semitrailer collided with a parapet of the Tunis Creek Bridge and traveled along the bridge

striking the curb and railing. The truck then jackknifed and struck a bus traveling in the opposite lane of traffic. Both vehicles were engulfed in flames and totally destroyed. Nine fatalities, 20 injuries, and —90,000 property damage resulted. The probable cause of the accident was the disorientation of the intoxicated truck driver, who had a blood alcohol level of .185%. The co-driver of the truck was also intoxicated with a blood alcohol level of .21%.  
 HS-013 820

### CAN OUR SCHOOL BUSES BE MADE SAFER?

California Highway Patrolman v37 n7 p4-5, 22-4, 27-8 (Sept 1973)  
 W. L. Roper 1973  
 See serial citation

School bus safety, School bus accidents, School bus design, Vehicle train collisions, School bus bodies, Federal role, State action, School bus drivers, School bus standards

Two school bus train collisions are described and efforts to improve school bus safety are discussed. School bus safety factors that are currently being emphasized include improved seat and interior design; vehicle inspection, both regular and spot inspections to assure safe maintenance of all mechanical parts; driver training and inspection to assure that all school bus drivers are well trained; skillful, competent and are persons of good character and judgment; and constant over-all supervision of both personnel and equipment.  
 HS-013 827

## 5C. Cycles

### AN EVALUATION OF THE SAFETY PERFORMANCE OF TRICYCLES AND MINIBIKES

Calspan Corp., Buffalo, N. Y.  
 R. S. Rice 1972 109p 3refs Rept. No. PB-221 047, ZN-5144-K-1  
 Contract FDA-72-91  
 Report for 1 May-30 Sep 1972.  
 NTIS

Minibikes, Vehicle stability, Vehicle safety standards, Performance tests, Safety design, Vehicle center of gravity, Loading (mechanical), Pedals, Seat height, Steering, Cornering, Handlebars, Braking, Brake tests, Lateral acceleration, Pitch, Computerized simulation, Vehicle control, Federal role, Stopping distance, Rear suspension systems, Driver characteristics, Mathematical analysis, Tricycles

Performance of tricycles for 2-6 year old children is marked by speeds of 4 to 7 mph, unrestricted steering, and seat height to rear track ratios of approximately one. Tricycle stability is satisfactory for pitchover for the single rider but is inadequate for rollover in normal play. It is recommended that the Bureau of Product Safety consider safety standards covering rollover stability, seat height adjustability, limited steering angle, and removal of the rear step bar to discourage double riding. Performance of six minibikes was characterized by maximum speeds of 25 mph, braking decelerations of .5g, and tractive accelerations in the range of .2g. Potential problems of inadvertent acceleration wheelies, pitch and bounce stability over uneven terrain, braking control nonlinearities, and cornering limitations because of structural elements contacting the ground were observed. Recommendations for consideration in Bureau of Product Safety standards cover braking, suspension, cornering, and acceleration characteristics.  
 HS-013 822

## Group 5C—Cycles

**THE BIKEWAY PLAN****73P 10REFS**

Denver Planning Office, Rm. 300, 1445 Cleveland Place, Denver, Colorado 80202

Bikeway planning, Denver, Bicycle usage, Origin and destination studies, Travel patterns, Surveys, Bicycle safety, Bicycle accidents, Bicycle rider age, Transportation system costs, Buses, Travel time, Routes, Trip frequencies, Legal factors, Maps

This study was conducted to assess bicycle demand for routes; to develop a bike route plan; to estimate costs; and to develop implementation phases. Origin and destination questionnaires were distributed to current bicycle commuters. Downtown employees and students were surveyed; 23 intersections were monitored for bicycle travel; and interviews were conducted at four city parks to determine distance traveled to the park. The study showed a significant number of bicycle commuters and a still larger percentage of potential commuters if planned bikeways were available. A total system of 164 miles of planned bicycle routes is proposed. Tables (listed in the Appendix), describing the routes, mileage, estimated costs, traffic volumes, speed limits, and unusual situations associated with development of each bicycle route, and maps illustrating the routes are included. Types of bikeways, bicycle safety, legal factors, and a bicycle-bus system are also discussed.

HS-013 823

**5D. Design****DETERMINATION OF MODAL PROPERTIES OF AUTOMOTIVE BODIES AND FRAMES USING TRANSIENT TESTING TECHNIQUES**

Structural Dynamics Res. Corp., Cincinnati, Ohio

T. Sisson, R. Zimmerman, J. Martz 1973 13p 7refs Rept. No.

SAE-730502

Presented at Automobile Engineering Meeting, Detroit, 14-18 May 1973.

SAE

Dynamic structural analysis, Body tests, Frame tests, Stiffness, Damping, Inertia, Test equipment, Fourier analysis, Transfer functions, Frequencies, Excitation, Dynamic tests, Digital computers

Methods of determining modal stiffness, inertia, and damping properties of automotive bodies and frames using transient testing techniques are described. The test equipment described is a digital Fourier analyzer system. The hardware and software used to obtain transfer functions of the vehicle components is discussed, and several examples are presented which compare frequency response data generated by the Fourier analyzer to the same data generated by the more standard sinusoidal excitation methods.

HS-013 785

**ESV TEST METHODOLOGY AND RESULTS**

National Hwy. Traf. Safety Administration, Washington, D. C.; Ultrasystems, Inc., Newport Beach, Calif.

N. S. Stahler, F. Arndt 1973 16p Rept. No. SAE-730590

Presented at Automobile Engineering Meeting, Detroit, 14-18 May 1973.

SAE

Experimental automobiles, Safety cars, Performance tests, Accident avoidance, Injury prevention, Test facilities, Test equip-

ment, Data acquisition, Anthropomorphic dummies, Barrier collision tests, High speed impact tests, Pole impact tests, Side impact tests, Automobile dimensions, Brake tests, Yaw, Stopping distance, Pedal force, Steering tests, Automobile handling, Returnability tests, Lateral acceleration, Vehicle visibility, Postcrash phase, Rear end impact tests, Vehicle vehicle impact tests, Head impact tolerances, Leg impact tolerances, Chest impact tolerances, Pelvic acceleration tolerances, Air bag restraint systems

Tests of brake and steering performance, handling, stability, visibility, displays and controls, engines, and ride performance were conducted for the Fairchild Industries, Inc., General Motors Corp., and American Machine and Foundry Co. experimental safety vehicles. The cars were also subjected to impact tests and a subjective pedestrian safety evaluation to determine their effectiveness in preventing injuries. An evaluation of design requirements and postcrash factors, including fuel and electrical system damage, potential fire hazards, glazing standard compliance, and emergency egress and passenger rescue, was also performed. Test procedures and results are summarized.

HS-013 787

**ENGINEERING KNOW-HOW IN ENGINE DESIGN,****PT. 21****58P REFS Rept. No. SAE-SP-379**

Includes HS-013 789--HS-013 793.

SAE

Engine design, Steam automobiles, Rankine cycle engines, Gas turbine engines, Electric automobiles, Hybrid automobiles, Stirling engines, Flywheels, Exhaust emission control, Experimental engines

Air pollution by automobiles is recognized as a serious national problem that has precipitated a series of state and federal regulations governing the maximum allowable level of exhaust pollutants. To date, these laws have been satisfied through modifications of the conventional internal combustion engine. However, as the regulations become more stringent, these modifications will become more costly and troublesome. As a result, engine manufacturers and government agencies are investigating alternative powerplants. Some of these alternative systems, including steam engines, gas turbine engines, electric and hybrid automobiles, Stirling engines, and flywheel engines are discussed.

HS-013 788

**AN INTRODUCTION TO THE VEHICULAR GAS TURBINE ENGINE**

Engineering Know-How in Engine Design, Pt. 21 (SAE-SP-379), New York, 1973 p9-27

General Motors Res. Labs., Warren, Mich.

C. A. Amann 1973 32refs Rept. No. SAE-730618

In HS-013 788

Gas turbine engines, Engine design, Compressors, Turbines, Brayton cycle engines, Thermal efficiency, Heat exchangers, Performance characteristics, Combustion chamber design, Engine operating conditions, Engine performance, Exhaust emission control, Engine modification, Nitrogen oxides, Ceramics

The movement toward commercial use of the gas turbine engine in automotive vehicles has slowly progressed to the point of im-

minence in certain heavy-duty applications. Recently, interest in light-duty application to the passenger car has been stimulated by concern over exhaust emissions. The developmental history of the engine for automotive use is traced, insight is given into the characteristics of the engine components and their function in the complete powerplant, and some recent activities in the gas turbine field are discussed.  
HS-013 790

### INTERNATIONAL CONFERENCE ON VEHICLE MECHANICS (2ND) PROCEEDINGS, PARIS, SEPTEMBER 6-9, 1971

Paris Univ. (France)  
P. Rapin, ed., H. K. Sachs, ed. 1973 503p refs  
Prepared in cooperation with the French Society of Automotive Engineers (SIA) and Wayne State Univ. Includes HS-013 801--HS-013 811.  
Swets and Zeitlinger B. V., Amsterdam, Netherlands

Vehicle mechanics, Vehicle design, Mathematical models, Computerized simulation, Vehicle dynamics, Automobiles, Motorcycles, Off the road vehicles, Vehicle performance, Amphibious vehicles, Air cushion vehicles, Railroads

Manuscripts and abstracts of lecture presentations on the four major conference topics, automobile dynamics, rail vehicle systems, off the road vehicle systems, and ships and hovercrafts, are presented. Taken as a whole, the conference proceedings give an indication of the state of research in the field of vehicle dynamics.  
HS-013 800

### THREE IMPERATIVES IN THE AUTOMOBILE FUTURE

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p37-57  
Virginia Polytechnic Inst. and State Univ., Blacksburg  
R. L. Whitelaw 1973  
In HS-013 800

Automobile design, Fuel consumption, Hydrostatic transmissions, Electric automobiles, Body design, Energy conservation, Flywheels, Body aerodynamics, Air pollution control, Drag

Private automobiles consume 160 billion gallons of fuel every year and contribute almost two trillion kg. of pollutants to the atmosphere. Three technically feasible ways to significantly reduce automobile fuel consumption and its attendant air pollution and still preserve the automobile as personal transportation device are described. Use of hydrostatic transmissions in automobiles could save a potential 20 billion gallons of fuel annually; the manufacture of a non-polluting local duty vehicle which combines a filament-wound flywheel for energy storage and lead acid battery for power surge, would save almost 25 billion gallons per year in fuel; and the design of an aerodynamically cleaner automobile body would yield an additional annual fuel saving of 15 billion gallons.  
HS-013 803

### AERODYNAMIC AND ROLLING RESISTANCES OF VEHICLES AS OBTAINED FROM COAST-DOWN EXPERIMENTS

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p146-60  
Illinois Univ., Urbana  
H. H. Korst, R. A. White 1973 16refs

In HS-013 800

Coast down tests, Drag, Tire rolling resistance, Aerodynamics, Statistical analysis, Slopes, Wind, Mathematical analysis, Equations, Least squares method, Time factors, Kinetic energy

Coast down experiments can be utilized by proper processing of time vs. speed data for obtaining individual information on both aerodynamic drag and the rolling resistance. The differential equation describing the decrease in kinetic energy of the vehicle can be integrated in closed form if the rolling resistance remains reasonably constant over the velocity range covered in the coast down test. The theoretical solution, which also accounts for such deterministic external influences as road slope and headwind, is subsequently utilized for the statistical processing of test data. A least square fit for elapsed time eliminates both random and deterministic errors when experiments are run twice in opposing directions and two statistically determined parameters allow the calculation of the aerodynamic drag coefficient and the specific rolling resistance of the vehicle. Correlation of coast down data by a single normalized coast down curve is supported by experimental data.  
HS-013 808

### CORRECTION FOR THE EFFECT OF AMBIENT CONDITIONS ON VEHICLE ACCELERATIVE PERFORMANCE

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p161-80  
Loughborough Univ. of Technology, Leics. (England)  
G. G. Lucas, R. A. Stoker, R. Mizon 1973 22refs  
In HS-013 800

Acceleration, Acceleration onset rate, Engine response time, Mathematical analysis, Ambient temperatures, Wind velocity, Barometric pressure, Performance characteristics, Test reproducibility, Computerized simulation, Engine speeds, Power output, Computer programs, Torque, Drag, Speed, Data processing, Vehicle performance

Techniques have been devised to correct vehicle time-to-speed test results for the ambient conditions of steady wind along the direction of the test track, pressure, and temperature. Advances in vehicle instrumentation have made it necessary to devise these correction techniques in order to obtain acceptable repeatability of results. In devising these techniques a vehicle performance computer program was used rather than actual test results. Two separate correction techniques are presented in order to cater to the two main techniques of handling experimental time-to-speed data: sophisticated instrumentation employing advanced recording and processing facilities and manual recording of time-speed values. These techniques have yet to be subjected to actual field test results but experience from using the vehicle performance computer program suggests that their use is a considerable advance in obtaining repeatability from time-to-speed tests.  
HS-013 809

### VEHICLE COLLISIONS--A PRELIMINARY STUDY OF IMPACT OVERLOAD IN ONE DIMENSIONAL, MULTIPLE DEGREE OF FREEDOM STRUCTURAL SYSTEMS

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p207-16  
England Ministry of Defence, London; Sheffield Univ., Yorks. (England)  
R. N. Newman, B. Rawlings 1973 6refs

## Group 5D—Design

Prepared in cooperation with the Science Res. Council  
In HS-013 800

Automobile modeling, Dynamic models, Model tests, Structural deformation analysis, Kinetic energy, Impact velocity, Energy absorption, Impact tests

A preliminary study of the nonlinear behavior of a structural system subjected to impact overload is presented. A simple model with five elements, representing the mass of the engine, the passenger compartment and the passengers, and their interconnecting structure is described. The results of dynamic tests on the model are explained and discussed in terms of both a simple theory and the practical problem of locating the engine with respect to the energy absorbing structure and passenger restraint system in a frontal crash.  
HS-013 810

**THE ECONOMICS OF BUMPER DESIGN**

International Conference on Vehicle Mechanics (2nd)  
Proceedings, Amsterdam, 1973 p251-65  
Brigham Young Univ., Provo, Utah  
C. Y. Warner 1973 17refs  
In HS-013 800

Bumper design, Benefit cost analysis, Impact protection, Energy absorbing bumpers, Damage costs, Parts costs, Damage prevention, Impact velocity

Energy absorption systems now being designed as bolt-on accessories to conventional body-frame structures are limited, not only by frame strength and styling geometry, but by the potential dollar loss reduction they can provide. A benefit cost study concerning the payoff of bumper protection is presented. The analysis provides approximate design guidelines, suggesting a maximum break-even bumper design speed of between six and nine mph. The optimum design speed for bumper systems to protect current automobiles is near 5 mph. As automobiles are equipped with stronger frames and bodies, allowing increased frame loading, the optimum bumper design speed will probably increase. Until such stronger frame-body structures can be economically produced, however, increases in effective bumper speed above 5 mph will very possibly be counterproductive.  
HS-013 811

**AN EVALUATION OF THE SAFETY PERFORMANCE OF TRICYCLES AND MINIBIKES**

Calspan Corp., Buffalo, N. Y.  
For primary bibliographic entry see Fld. 5C.  
HS-013 822

**5F. Fuel Systems****CATALYTIC NITROGEN OXIDES REDUCTION STUDIES**

Union Oil Co. of California, Los Angeles  
H. R. Jackson, D. P. McArthur, H. D. Simpson 1973 6p 18refs  
Rept. No. SAE-730568  
Presented at Automobile Engineering Meeting, Detroit, 14-18 May 1973.  
SAE

Nitrogen oxides, Reduction catalysts, Catalyst tests, Performance characteristics, Catalyst poisoning, Deactivation, Durability tests, Sulfur dioxide, Lead acetate, Laboratory tests

Hundred of catalysts have been evaluated in bench activity tests, using synthetic engine exhaust gas to determine conversion of nitrogen oxides. Many of these catalysts were also exposed to actual engine exhaust in an engine dynamometer test, and then re-evaluated in the bench apparatus to determine the degree of catalyst deactivation. For catalysts prepared on non-reactive, hydrothermally stable support materials, it was found that the primary causes of deactivation were sulfur and lead poisoning. Subsequently, it was determined that deactivation of a nitrogen oxide catalyst from sustained exposure to engine exhaust can be closely simulated by impregnating the fresh catalyst with lead acetate to the required lead level, followed by testing the catalyst with sulfur dioxide present in the synthetic exhaust gas. These studies have resulted in the development of catalysts showing high initial nitrogen oxide conversion efficiency and little deactivation in engine tests.  
HS-013 786

**ENGINEERING KNOW-HOW IN ENGINE DESIGN, PT. 21**

**58P REFS Rept. No. SAE-SP-379**

Includes HS-013 789--HS-013 793.  
SAE

Engine design, Steam automobiles, Rankine cycle engines, Gas turbine engines, Electric automobiles, Hybrid automobiles, Stirling engines, Flywheels, Exhaust emission control, Experimental engines

Air pollution by automobiles is recognized as a serious national problem that has precipitated a series of state and federal regulations governing the maximum allowable level of exhaust pollutants. To date, these laws have been satisfied through modifications of the conventional internal combustion engine. However, as the regulations become more stringent, these modifications will become more costly and troublesome. As a result, engine manufacturers and government agencies are investigating alternative powerplants. Some of these alternative systems, including steam engines, gas turbine engines, electric and hybrid automobiles, Stirling engines, and flywheel engines are discussed.  
HS-013 788

**AUTOMOTIVE STEAM POWER--1973**

Tennessee Technological Univ., Cookeville  
For primary bibliographic entry see Fld. 5O.  
HS-013 789

**AN INTRODUCTION TO THE VEHICULAR GAS TURBINE ENGINE**

General Motors Res. Labs., Warren, Mich.  
For primary bibliographic entry see Fld. 5D.  
HS-013 790

**COMPARISON OF EMISSION INDEXES WITHIN A TURBINE COMBUSTOR OPERATED ON DIESEL FUEL OR METHANOL**

Ford Motor Co., Dearborn, Mich.  
C. W. LaPointe, W. L. Schultz 1973 19p 16refs Rept. No. SAE-730669  
Presented at National Powerplant Meeting, Chicago, 18-22 June 1973.  
SAE

Gas turbine engines, Exhaust emission control, Diesel fuels, Methanols, Exhaust emission sampling, Air fuel ratio, Fuel mixture temperature, Mathematical analysis, Data reduction

The emission index (grams of species per kilogram of fuel) field within a regenerative turbine combustor has been mapped using a water-cooled sampling probe. The probe employed a choked orifice to simultaneously determine the local temperature. Derived from measurements are: air fuel ratio, combustion efficiency, average fuel velocity, and fuel distribution factor. Methods of averaging the discrete data are developed. A comparison of the data obtained when the combustor was operated on each of two fuels revealed that the use of methanol leads to lower nitric oxide but higher carbon monoxide emission than does the use of diesel fuel.

HS-013 796

#### PERFORMANCE OF A HOMOGENEOUS COMBUSTOR FOR A RANKINE CYCLE STEAM ENGINE

Scientific Energy Systems Corp., Watertown, Mass.  
J. Gerstmann, F. Pompei 1973 11p 7refs Rept. No. SAE-730671  
Presented at Combined Commercial Vehicle Engineering and Operations and Powerplant Meetings, Chicago, 18-22 Jun 1973.  
SAE

Rankine cycle engines, Engine design, Exhaust emission control, Boilers, Engine performance, Engine operating conditions, Nitric oxide, Unburned hydrocarbons, Quenching, Carbon monoxide

A compact gasoline-fired homogeneous combustor has been developed for use in a Rankine cycle steam generator. The combustor takes advantage of staged cooling of the combustion products to limit the formation of nitric oxide while promoting the oxidation of carbon monoxide. The principles of operation and some of the design details of the burner are described. Steady-state emissions measurements are presented, and the performance of the staged quenching is compared with its predicted performance.

HS-013 797

#### LOW EMISSION COMBUSTOR DEVELOPMENT FOR AUTOMOTIVE RANKINE-CYCLE ENGINES

Thermo Electron Engineering Corp., Waltham, Mass.  
For primary bibliographic entry see Fld. 50.  
HS-013 798

#### THREE IMPERATIVES IN THE AUTOMOBILE FUTURE

Virginia Polytechnic Inst. and State Univ., Blacksburg  
For primary bibliographic entry see Fld. 5D.  
HS-013 803

#### TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN BALTIMORE, MARYLAND. FINAL REPORT

240P REFS Rept. No. APTD-1443  
Contract EPA-68-02-0041  
Report for 14 Aug 1972-15 Dec 1972.  
Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Emission control, Transportation planning, Air quality standards, Baltimore, Vehicle air pollution, Forecasting, Air pollu-

tion measurement, Air pollution emission factors, Vehicle mileage, Carbon monoxide, Oxidizers, Traffic density, Vehicle age, Retrofitting, Vehicle inspection, Vehicle maintenance, Hydrocarbons, Traffic flow, Traffic control, Public transportation, Car pools, Transportation regulation, Parking prohibitions, Staggered work times, Fuel taxation, Fares, Central business districts, Economic factors, Political factors, Legal factors, Bus lanes, Sociological factors

Methods of controlling carbon monoxide and oxidant emissions to meet 1977 air quality standards in Baltimore are presented. The contribution of vehicle miles of travel to air pollution is emphasized. The effectiveness of suggested transportation controls, including retrofitting, vehicle inspection and maintenance, gaseous fuel conversion, traffic flow improvements, transit service improvements, car pools, parking prohibitions, staggered work times, and increased fuel taxes, is evaluated. The air quality impact of these transportation controls is estimated and surveillance methods and obstacles facing implementation of the suggested controls are outlined.

HS-013 843

#### TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN SPOKANE, WASHINGTON. FINAL REPORT

124P Rept. No. APTD-1448  
Contract EPA-68-02-0041  
Report for 14 Aug-15 Dec 1972.  
Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Exhaust emission control, Transportation planning, Air quality standards, Spokane, Air pollution, Forecasting, Traffic surveillance, Carbon monoxide, Oxidizers, Hydrocarbons, Air pollution measurement, Exhaust densities, Seasons, Central business districts, Month, Time of day, Traffic flow, Traffic volume, Vehicle age, Air pollution sources, Computer controlled signals, Rapid transit systems, Retrofitting, Engine conversion, Parking regulations, Car pools, Staggered work times, Driver aid systems, Loading areas

Methods of controlling carbon monoxide and oxidant emissions to meet 1977 air quality standards in Spokane are presented. The contribution of vehicle miles of travel to air pollution is emphasized. The effectiveness of suggested transportation controls, including a computer controlled downtown signal system, rapid transit improvement, retrofitting, gaseous fuel conversion, second-level sidewalks, fringe parking, driver advisories, car pools, staggered work days, loading area control, and discouraging the use of older vehicles, is evaluated. Surveillance methods and obstacles facing implementation of traffic controls are outlined. The air quality impact of transportation controls is estimated.

HS-013 844

#### TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSION IN BOSTON, MASSACHUSETTS. FINAL REPORT

262P 24REFS Rept. No. APTD-1442  
Contract EPA-68-02-0041  
Report for 14 Aug-15 Dec 1972.  
Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

## Field 5—VEHICLE SAFETY

HSL 74, No. 3r

### Group 5F—Fuel Systems

Exhaust emission control, Transportation planning, Air quality standards, Boston, Air pollution measurement, Forecasting, Vehicle mileage, Carbon monoxide, Oxidizers, Hydrocarbons, Traffic flow, Bypasses, Traffic surveillance, Rapid transit systems, Retrofitting, Vehicle maintenance, Vehicle inspection, Engine conversion, Traffic control, Parking regulations, Staggered work times, Air quality standards, Exhaust densities, Seasons, Time of day, Vehicle characteristics, Travel patterns, Travel demand, Loading areas, Traffic free zones, Car pools, Fuel taxation, Fuel rationing, Vehicle age, Central business districts

Methods of controlling carbon monoxide and oxidant emissions to meet 1977 air quality standards in Boston are presented. The contribution of vehicle miles of travel to air pollution is emphasized. The effectiveness of suggested transportation controls, including driver advisory displays, gasoline rationing, increased fuel taxes, car pools, bypassing through traffic in downtown, vehicle free zones and moving sidewalks, retrofitting, vehicle inspection and maintenance, gaseous fuel conversion, improved traffic flow, loading area control, reduced travel demand, increased transit use, modification of travel patterns, and fringe parking, is evaluated. Surveillance methods and obstacles facing implementation of traffic controls are outlined. The air quality impact of transportation controls is estimated.

HS-013 845

### EVALUATING TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN MAJOR METROPOLITAN AREAS

365P 151REFS Rept. No. APTD-1364

Contract EPA-68-02-0048

In cooperation with TRW, Inc.

Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Emission control, Transportation planning, Vehicle air pollution, Air quality standards, Urban areas, Carbon monoxide, Air pollution control costs, Vehicle inspection, Vehicle maintenance, Retrofitting, Exhaust emission measurement, Fuel systems, Denver, Natural gas, Liquefied petroleum gases, Automobile modification, Public transportation costs, Traffic flow, Traffic management, Traffic engineering, Bypasses, Belt highways, Public transportation, Transportation regulation, Traffic bans, Chicago, Parking regulations, Staggered work times, Federal role, State action, Political factors, Legal factors, Economic factors, District of Columbia, New York (City), Los Angeles, San Francisco

Transportation controls which could conceivably reduce motor vehicle emissions in the next few years are described and evaluated. Priority was given to those transportation controls capable of being introduced by 1977 to reduce carbon monoxide emissions from light duty motor vehicles. The study concentrated on large metropolitan areas, with specific reference to Chicago, Denver, Los Angeles, New York City, San Francisco, and Washington, D. C. Transportation controls discussed include inspection, maintenance, and retrofit; gaseous fuel systems; traffic flow techniques; bypassing through traffic; improvements in public transportation; motor vehicle restraints; and work schedule changes. An analysis of the air pollution control potential of each control, including an estimate of the maximum feasible emission reductions which would be possible, and a discussion of institutional feasibility, including probable costs, are presented.

HS-013 846

### PREDICTION OF THE EFFECTS OF TRANSPORTATION CONTROLS ON AIR QUALITY IN MAJOR METROPOLITAN AREAS

131P REFS Rept. No. APTD-1363

Contract EPA-68-02-0048

Environmental Protection Agency, Research Triangle Park, North Carolina 27711; NTIS

Exhaust emission control, Transportation planning, Air quality standards, Urban areas, Forecasting, Air pollution measurement, Chicago, New York (City), Denver, Los Angeles, San Francisco, District of Columbia, Carbon monoxide, Hydrocarbons, Nitrogen oxides, Vehicle inspection, Vehicle maintenance, Traffic flow, Traffic control, Vehicle mileage, Air pollution sources, Exhaust densities, Vehicle air pollution

The data collection and specific analysis performed to predict the effects of transportation controls on the air quality of Chicago, New York City, Denver, Los Angeles, San Francisco, and the District of Columbia are presented. The sources of transportation and other data are identified and the limitations of the data base are described. Analytic projections of emission rates and predicted concentration levels are given for each of the defined transportation control conditions. A more detailed discussion of the transportation control methodology for the District of Columbia, which was used as a test case for development of analytic procedures, is presented.

HS-013 847

### EXHAUST EMISSIONS FROM GASOLINE-POWERED VEHICLES ABOVE 6,000-LB. GROSS VEHICLE WEIGHT. FINAL REPORT

Southwest Res. Inst., San Antonio, Tex.

K. J. Springer, C. D. Tyree 1972 433p 11 refs Rept. No. PB-220

365, APTD-1520

Contract EHS-70-110

NTIS

Exhaust emission tests, Heavy duty vehicles, Exhaust emission sampling, Engine tests, Road tests, Nitrogen oxides, Carbon monoxide, Hydrocarbons, Truck tests, Test equipment, Chemiluminescence, Steady state, Exhaust emission measurement, Laboratory tests, Engine speeds, Loading (mechanical), Fuel consumption, Chevrolets, Fords, Computer printouts, Driver behavior, Exhaust densities, Instrumented vehicles

A nine-truck evaluation of a 23-mode test procedure was conducted, using stationary- and chassis-operated engines. The studies determined that power output level influenced all emissions more than any other variable, and illustrated the need to measure emissions at increments approaching 10 to 15% power intervals. Speed had a minor effect on emission rates. Acceleration at wide open throttle against sizeable inertia produced emissions representative of some steady state conditions. The different road routes, stop-and-go, and slow, intermediate, and high speed had a significant influence on reducing hydrocarbons with increase in engine speed, vehicle speed, and power level. The opposite trend was found for nitrogen oxides with minimum hydrocarbon, carbon monoxide, and nitrogen oxide emissions at constant speeds of 20 to 30 mph. Stationary and chassis dynamometer versions of the 23-mode test procedure were workable with excellent run-to-run repeatability and satisfactory chassis-to-stationary agreement.

HS-013 899



## 5I. Inspections

### **INSPECTION HANDBOOK FOR PASSENGER CARS, TRUCKS AND BUSES, MOTORCYCLES, SCHOOL BUSES, FOREIGN VEHICLES THROUGH 1973 MODELS WITH MANUFACTURERS' RECOMMENDATIONS**

276P

Prepared in cooperation with American Assoc. of Motor Vehicle Administrators, Washington, D. C. Cover title: Vehicle Inspection Handbook.  
Corporate author

Inspection standards, Manuals, Steering inspection, Suspension system inspection, Brake inspection, Wheel inspection, Tire inspection, Body inspection, Exhaust system inspection, Fuel system inspection, Bus inspection, Station wagons, Electric systems, Lighting inspection, Glass inspection, Vehicle registration, Inspection procedures, Alignment inspection, Inspection equipment, Exhaust emission control devices, Motorcycle inspection, Truck inspection, Automobile inspection

This looseleaf handbook interprets the requirements of the American National Standards Institute Standard D7.1 - 1968, plus several contemplated changes in the Standard which is being revised in 1973. Descriptions of registration, wheel, tire, steering alignment, suspension system, lighting, electrical system, glass body and sheet metal and exhaust and fuel system inspection procedures and objective statements of causes for rejection are presented for passenger cars, trucks, and buses. Inspection procedures for vehicle emission and control systems are included for passenger cars.  
HS-013 828

## 5J. Lighting Systems

### **SRCH: A HEADLAMP RESEARCH PROGRAM FOR THE EXTRAPOLATION/INTERPOLATION OF SURFACE VALUES FROM A PREDEFINED GRID**

National Aeronautical Establishment, Ottawa, Ont. (Canada)  
A. L. Harrison 1972 71p 4refs Rept. No. LTR-ST.602  
Corporate author

Computer programs, Headlamp design, Computerized design, Flow charts, Mathematical analysis, Data processing, Headlamp brightness, Fortran

The SRCH program provides a facility for the interpolation and extrapolation of values from a grid surface. Various methods for describing the grid surface and for extracting the required surface values are examined and their implementation as part of the SRCH program is discussed. The source listing for the program and a sample execution of the program are included. The program is written in Fortran for the IBM 360/67 TSS computer at National Research Council and utilizes the contour plotting package.  
HS-013 778

### **CONTOUR PLOTTING OF THE HEADLAMP ILLUMINATION MAPS; MAPPING THE ILLUMINATION ON A TARGET PLANE AND AT THE EYE**

National Aeronautical Establishment, Ottawa, Ont. (Canada)  
A. Harrison 1972 52p Rept. No. LTR-ST.531  
Corporate author

Headlamp brightness, Computerized design, Plotters, Lighting, Goniometers, Computer programs, Headlamp aiming, Isocandela plots

The organization of the illumination data for the tested headlamps obtained from the goniometer measurements; contour plotting of the headlamp illumination map; computing the illumination map at the eye for a given arrangement of headlamps under particular conditions; and the illumination on a target plane are discussed. The range and measurement of the data values according to the goniometer orientation are presented, together with the method of storage on cards and on disk files of both the illumination and angular values. A description is provided of the plot program and the different contour plots produced. The determination and use of the illumination maps which produce a total illumination map at the eye are shown and the mapping of the illumination falling directly on a target plane is described, the organization and interrogation of this map are discussed, and an example is given.  
HS-013 779

## 50. Propulsion Systems

### **ENGINEERING KNOW-HOW IN ENGINE DESIGN, PT. 21**

58P REFS Rept. No. SAE-SP-379  
Includes HS-013 789--HS-013 793.  
SAE

Engine design, Steam automobiles, Rankine cycle engines, Gas turbine engines, Electric automobiles, Hybrid automobiles, Stirling engines, Flywheels, Exhaust emission control, Experimental engines

Air pollution by automobiles is recognized as a serious national problem that has precipitated a series of state and federal regulations governing the maximum allowable level of exhaust pollutants. To date, these laws have been satisfied through modifications of the conventional internal combustion engine. However, as the regulations become more stringent, these modifications will become more costly and troublesome. As a result, engine manufacturers and government agencies are investigating alternative powerplants. Some of these alternative systems, including steam engines, gas turbine engines, electric and hybrid automobiles, Stirling engines, and flywheel engines are discussed.  
HS-013 788

### **AUTOMOTIVE STEAM POWER--1973**

Engineering Know-How in Engine Design, Pt. 21 (SAE-SP-379), New York, 1973 p1-8  
Tennessee Technological Univ., Cookeville  
A. W. Gardiner 1973 28refs Rept. No. SAE-730617  
In HS-013 788

Steam automobiles, Rankine cycle engines, Exhaust emission control, Exhaust emission measurement, Boilers, Steam condensers, Rankine cycle engine fluids, Expanders, Steam turbines, Thermal efficiency, Fuel consumption, Freezing, Water

Early steam car performance is briefly reviewed and the results of current research are summarized with emphasis on problems such as emissions, safety, cold-start delay, freezing, choice of working fluid, control systems, and fuel consumption. It is concluded that a Rankine cycle powerplant can meet 1976 federal standards for emission. Alternate fluids for steam engines are discussed, but water is still competitive, as is the piston engine.  
HS-013 789

Group 50—Propulsion Systems

**ELECTRIC AND ELECTRIC-HYBRID CARS—EVALUATION AND COMPARISON**

Engineering Know-How in Engine Design, Pt. 21 (SAE-SP-379), New York, 1973 p36-47  
Wisconsin Univ., Madison  
N. H. Beachley, A. A. Frank 1973 6refs Rept. No. SAE-730619  
In HS-013 788

Electric automobiles, Hybrid automobiles, Experimental automobiles, Electric automobile design, Electric automobile range, Performance characteristics, Electric motors, Batteries

The design and performance aspects of electric and electric-hybrid powerplants are discussed. A realistic appraisal of the limitations as well as the strong points of various designs and concepts is presented. The electric car has many features that make it attractive for urban use. Currently, its principal shortcomings are its short range and poor efficiency for a realistic driving cycle. An electric hybrid car of advanced design, such as the University of Wisconsin model described here, can overcome the limitations of the all-electric car, while retaining most of its advantages, but only at the expense of greater complexity. More research and development is required before either version can be an adequate replacement for our present internal combustion engine cars.

HS-013 791

**COMPARATIVE ANALYSIS OF STIRLING AND OTHER COMBUSTION ENGINES**

Engineering Know-How in Engine Design, Pt. 21 (SAE-SP-379), New York, 1973 p36-47  
Wayne State Univ., Detroit, Mich.  
S. R. Davis, N. A. Henein 1973 31refs Rept. No. SAE-730620  
In HS-013 788

Stirling engines, Engine design, Engine performance, Performance characteristics, Thermodynamics, Thermal efficiency, Hydrocarbons, Carbon monoxide, Nitric oxide, Smoke, Gas turbine engines, Steam engines, Diesel engines, Exhaust gas recirculation, Weight to power ratio

The development of the Stirling engine has recently gained momentum because of technological advances as well as the need to explore alternative power systems for meeting environmental concerns. An overview of the Stirling engine principles, taking into account the ideal as well as the actual cycle, is presented. The analysis examines the various design aspects and the performance and emission characteristics. A comparison is made between the Stirling and other continuous and cyclic combustion engines, such as the gasoline, diesel, gas turbine, and steam engines. This includes recent designs for the Rankine cycle and gas turbine combustors being considered for automotive applications.

HS-013 792

**IS THERE A FLYWHEEL IN YOUR FUTURE?**

Lockheed Missiles and Space Corp., Atherton, Calif.  
L. J. Lawson 1973 8refs  
In HS-013 788

Flywheels, Hybrid power trains, Kinetic energy, Drive systems, Vehicle design, Experimental vehicles, Urban automobiles, Performance characteristics, Propulsion systems

The recent rediscovery of the kinetic energy flywheel as a highly effective energy storage system provides several new candidate propulsion systems either in heat engine/flywheel

hybrid or pure flywheel-drive configurations. The specific energy of present-day flywheels is sufficient to make flywheel-only vehicles practical for urban route applications with ranges up to 30 km. Flywheel/heat-engine hybrid vehicles are entirely feasible for family and commuter car applications.

HS-013 793

**LOW EMISSION COMBUSTOR DEVELOPMENT FOR AUTOMOTIVE RANKINE-CYCLE ENGINES**

Thermo Electron Engineering Corp., Waltham, Mass.  
R. K. Sakhuja, A. D. Vasilakis 1973 13p 8refs Rept. No. SAE-730672  
Presented at Combined Commercial Vehicle Engineering and Operations and Powerplant Meetings, Chicago, 18-22 June 1973.  
SAE

Rankine cycle engines, Combustion chamber design, Exhaust emission tests, Exhaust emission control, Exhaust emission measurement, Carbon monoxide, Exhaust gas recirculation, Atomizing, Air fuel ratio, Test facilities, Hydrocarbons, Nitrogen oxides

The development of two low emission combustors for an automotive Rankine cycle engine is described. Emphasis has been placed on low emissions, fast response, compactness, and low parasitic power. Air atomization and rotary atomization of fuel have been incorporated, leading to two different combustor configurations. Emission characteristics of hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides are described for both concepts. HC and CO emissions have been generally found to be well below 1976 federal standards for automotive emissions. Fine atomization of fuel and thorough air-fuel mixing have been found to be the keys to low nitrogen oxides emissions. The use of exhaust gas recirculation reduced nitrogen oxides emissions significantly. Effects of excess air and cooled primary zone are also shown.

HS-013 798

**THREE IMPERATIVES IN THE AUTOMOBILE FUTURE**

Virginia Polytechnic Inst. and State Univ., Blacksburg  
For primary bibliographic entry see Fld. 5D.  
HS-013 803

**5R. Steering Control Systems**

**MEASUREMENT AND SUBJECTIVE EVALUATION OF VEHICLE HANDLING**

Ford Motor Co., Dearborn, Mich.  
W. Bergman 1973 26p 24refs Rept. No. SAE-730492  
Presented at Automobile Engineering Meeting, Detroit, 14-18 May 1973.  
SAE

Vehicle handling, Vehicle control, Driver vehicle interface, Driving task analysis, Driver skills, Performance tests, Evaluation, Driver performance, Man machine systems, Instrumented vehicles, Vehicle dynamics, Cornering, Braking, Steering tests, Vehicle performance

The nature of vehicle handling in real-world situations is analyzed and the importance of the driver is shown. A new concept which provides a basis for quantitative determination of vehicle handling qualities directly related to driver physical and mental efforts required for control of the vehicle is introduced.

A description of subjective evaluation techniques employed in developing vehicle designs for determinations of ease of vehicle control is presented, and a new method is introduced to quantitatively determine the evaluator's ability to appraise the ease of vehicle control. Vehicle directional response properties affecting the ease of vehicle control are identified, and new criteria expressing these properties are introduced. Test procedures to measure relevant vehicle directional response properties are developed. Good correlation is established between measurements and subjective evaluation.  
HS-013 784

**INTERNATIONAL CONFERENCE ON VEHICLE MECHANICS (2ND) PROCEEDINGS, PARIS, SEPTEMBER 6-9, 1971**

Paris Univ. (France)  
For primary bibliographic entry see Fld. 5D.  
HS-013 800

**DEFINITION, MEASUREMENT, AND PREDICTION OF MOTOR VEHICLE PERFORMANCE IN EXTREME MANEUVERS: A CHALLENGE TO THE VEHICLE DYNAMICIST**

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p9-36  
Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
L. Segel 1973  
HS-013 800, International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p9-36

Vehicle dynamics, Vehicle performance, Steering, Braking, Cornering, Vehicle stability, Vehicle handling, Tire forces, Tire mechanics, Roll, Yaw, Lateral acceleration, Lateral force, Longitudinal force, Displacement, Velocity, Automatic control, Wheel slip, Tire pavement interface, Tire loads, Forecasting, Simulation models, Tire traction

For purposes of defining the manner in which a vehicle performs in emergency maneuvers, it is expedient to employ the concept of a limit maneuver. A limit maneuver is any maneuver which causes the tires of a motor vehicle to operate in a region of peak shear force output, resulting in responses that are characterized by an anomalous or discontinuous behavior as the level or severity of the maneuver is increased. Some experimental findings developed in a study conducted to demonstrate the adequacy of the limit maneuver concept to discriminate among vehicles with respect to motion performance are presented, and the method of measuring limit maneuver performance is described. Difficulties in developing a predictive model of limit maneuver performance are discussed. The lack of detailed information on the shear force mechanics of tires constitutes the largest obstacle towards a predictive approach. The importance of tire traction to limit response is discussed.  
HS-013 802

**RIDE COMFORT AS INFLUENCED BY ASYMMETRIC SHOCK ABSORBER CHARACTERISTICS**

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p89-106  
Wayne State Univ., Detroit, Mich.  
R. N. Burns, H. K. Sachs 1973 4refs  
In HS-013 800

Suspension systems, Damping, Nonlinear systems, Mathematical analysis, Vibration response, Shock absorbers, Coulomb friction, Resonant frequency, Equations of motion, Displacement, Deflection, Vibration transmission, Vehicle dynamics, Vehicle riding qualities, Vibration analysis

The effects of nonlinear damping forces--viscous and dry friction damping--combined and separately, on the forced vibration response of a vehicle system are discussed. A recursion method is applied to solve the system equations of the asymmetrically damped system, a system for which the damping parameters assume different values for the compression and extension strokes of the motion across the damper. Significant data on the shift of the equilibrium position, amplitude response, and difference of part periods are obtained.  
HS-013 805

**A SIX DEGREE OF FREEDOM MODEL OF A CAR**

International Conference on Vehicle Mechanics (2nd) Proceedings, Amsterdam, 1973 p107-25  
Cranfield Inst. of Tech., Beds. (England)  
J. R. Ellis 1973 3refs  
In HS-013 800

Automobile modeling, Mathematical models, Vehicle dynamics, Vehicle handling, Equations of motion, Roll, Pitch, Yaw, Camber, Displacement, Vehicle mass, Kinetic energy, Suspension systems, Suspension system spring rates, Damping, Tire forces, Tire moments, Lateral force, Moments of inertia, Degrees of freedom

A six degree of freedom model of a car is described. The system has the capability of variable forward speed, sideslip, and yaw velocities together with bounce, pitch, and roll displacements. The concepts of sprung and unsprung masses and roll axes are not involved. Instead the vehicle is considered as a system of masses which are geared together so that a definite relation exists between the movements of the body and those of the suspension units. The equations may, in general, be applied about any desired set of axes although the system is most simple when certain conditions of axis location are considered. The conditions are equivalent to the motions about principal axes of rigid body dynamics.  
HS-013 806

**HYBRID COMPUTER SIMULATION STUDIES OF VEHICLE HANDLING**

Bendix Corp., Southfield, Mich.; Bendix Res. Labs., Southfield, Mich.  
For primary bibliographic entry see Fld. 5A.  
HS-013 807

**A COMPUTER BASED MATHEMATICAL METHOD FOR PREDICTING THE DIRECTIONAL RESPONSE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 2 TECHNICAL REPORT. MOTOR TRUCK BRAKING AND HANDLING PERFORMANCE STUDY**

Michigan Univ., Ann Arbor, Hwy. Safety Res. Inst.  
J. E. Bernard, C. B. Winkler, P. S. Fancher 1973 225p 18refs  
Rept. No. HSRI-PF-73-1, PB-221 630  
Sponsored by Motor Vehicle Manufacturers Assoc. of the United States, Inc.  
NTIS

## Group 5R—Steering Control Systems

Tractor trailers, Truck handling, Braking, Steering, Computerized simulation, Mathematical models, Vehicle kinematics, Fifth wheel couplers, Turning, Jackknifing, Truck tires, Yaw, Roll, Pitch, Moments of inertia, Wet road conditions, Dry road conditions, Tire road conditions, Steering systems, Suspension systems, Performance tests, Loading (mechanical), Road grades, Tire road contact forces, Dual tires, Vehicle mass, Lateral force, Sideslip, Torque, Deflection, Equations of motion, Flow charts, Algorithms, Tire properties, Tire pavement interface

Coordinate systems used to write the equations of motion for this directional response program; equations for expressing the displacements, velocities, and accelerations of pertinent points in the vehicle and the angular orientations, velocities, and accelerations of the sprung and unsprung masses which make up the vehicle; and mathematical models used to compute forces and moments acting on the sprung and unsprung masses are presented. Lateral and longitudinal shear forces generated at tire pavement interface, forces and moments coupled through the fifth wheel connection, gravitational force due to an inclined roadway, and the influence of steering system mechanics and wind loading are emphasized. The size and other operational aspects of the computer simulation and the measurement of the vehicle parameters needed to operate the simulation are discussed. Measured and simulated results of truck and tractor-trailer maneuvers are given for empty and loaded vehicles on a dry surface and empty vehicles on a wet surface. HS-013 821

#### THE EFFECT OF PAVEMENT ROUGHNESS ON SAFE VEHICLE HANDLING CHARACTERISTICS. FINAL REPORT

Purdue Univ., Lafayette, Ind.  
For primary bibliographic entry see Fld. 2D.  
HS-013 900

#### 5T. Trucks And Trailers

##### ANTI-SKID BRAKING OF A TRACTOR-SEMITRAILER TRUCK

For primary bibliographic entry see Fld. 5A.  
HS-013 780

##### THE HARMONIZATION OF TRUCK TECHNICAL REGULATIONS WITHIN THE EUROPEAN COMMON MARKET

Vauxhall Motors Ltd., Luton, Beds. (England)  
J. Alden 1973 21p Rept. No. SAE-730635  
SAE

Truck specifications, European vehicles, International compacts, Standardization, Design standards, Fuel tank standards, Bumper standards, Exhaust emission standards, Steering system design, Audio warning devices, Rearview mirrors, Brake standards, Noise standards, Exhaust emission control, Diesel engine exhaust emissions, Theft prevention devices, Vehicle lighting, Lighting standards, Vehicle height, Vehicle length, Tractor trailers, Performance tests, Occupant protection, Field of view, Control location, Vehicle registration, Vehicle inspection, Inspection standards

The difference between the rule-making procedure for commercial vehicles in Europe and the United States and the dif-

ferences between the European Type Approval system as compared with the American self-certification procedure are discussed. The parameters involved in the formation of the European organizing bodies and an interpretation of the relative importance of each organization are presented. The current list of Common Market Directives affecting truck design is explained with some comment on the reasoning behind them. Future technical regulation activity and the direction and trend of factors such as lighting and signaling, weights, dimensions, and performance criteria which will affect the future operation of all European commercial vehicles are outlined. The future classification method of rating vehicles is given, and reference is made to environmental trends on safety and exhaust emission. HS-013 794

##### THE MATHER JACKKNIFE CONTROL UNIT

Mather Co., Toledo, Ohio  
M. A. Ordorica 1973 7p 1ref Rept. No. SAE-730641  
Presented at Combined Commercial Vehicle Engineering and Operations and Powerplant Meetings, Chicago, 18-22 Jun 1973.  
SAE

Jackknifing, Tractor semitrailers, Vehicle control, Damping, Braking, Performance tests, Seals, Control arms, Yaw, Stopping distance, Truck stability, Wheel slip, Fluids, Antijackknifing devices, Articulated vehicle performance

Jackknifing occurs with and without braking whenever the slip angles of the rear tractor wheels exceed the value at which the maximum side force is developed. Jackknifing will occur even with partial skid of rear tractor wheels because the semitrailer pushes on the hitch introducing a yaw moment, which in turn, increases the tractor's yaw rate. Since no satisfactory solution is available to the jackknifing problem through controlled braking, the Mather Control Unit has been developed to provide low damping at low yaw rates and adequate counter torque at about 5 degrees per second to effectively control jackknifing with or without braking.

HS-013 795

##### INTERNATIONAL CONFERENCE ON VEHICLE MECHANICS (2ND) PROCEEDINGS, PARIS, SEPTEMBER 6-9, 1971

Paris Univ. (France)  
For primary bibliographic entry see Fld. 5D.  
HS-013 800

##### MOTOR CARRIER ACCIDENT INVESTIGATION. WILLIAM VOLKER AND COMPANY AND KERRVILLE BUS COMPANY. ACCIDENT--MARCH 7, 1973--BAKERSFIELD, TEXAS. NINE KILLED 17P Rept. No. 73-1

Corporate author

Accident case reports, Accident investigation, Truck accidents, Bus accidents, Driver intoxication, Accident caused fires, Centerline crossover collisions, Tractor semitrailers, Bridge parapets, Vehicle fixed object collisions, Accident location, Jackknifing, Driver characteristics, Vehicle characteristics, Accident causes, Blood alcohol levels, Bakersfield (Texas)

At 9:10 p.m. a westbound tractor semitrailer collided with a parapet of the Tunis Creek Bridge and traveled along the bridge striking the curb and railing. The truck then jackknifed and struck a bus traveling in the opposite lane of traffic. Both vehi-

February 27, 1974

**VEHICLE SAFETY—Field 5**  
**Wheel Systems—Group 5V**

cles were engulfed in flames and totally destroyed. Nine fatalities, 20 injuries, and —90,000 property damage resulted. The probable cause of the accident was the disorientation of the intoxicated truck driver, who had a blood alcohol level of .185%. The co-driver of the truck was also intoxicated with a blood alcohol level of .21%.  
HS-013 820

**A COMPUTER BASED MATHEMATICAL METHOD FOR PREDICTING THE DIRECTIONAL RESPONSE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 2 TECHNICAL REPORT. MOTOR TRUCK BRAKING AND HANDLING PERFORMANCE STUDY**  
Michigan Univ., Ann Arbor, Hwy. Safety Res. Inst.  
For primary bibliographic entry see Fld. 5R.  
HS-013 821

**MOTOR CARRIER ACCIDENT INVESTIGATION. MICKOW CORPORATION ACCIDENT--APRIL 3, 1973--NEAR DAVENPORT, IOWA**  
**9P Rept. No. 73-2**  
Corporate author

Accident case reports, Accident investigation, Ran off road accidents, Single vehicle accidents, Vehicle fixed object collisions, Truck accidents, Drug caused accidents, Tractor semitrailers, Amphetamines, Accident location, Time of accidents, Driver records, Ejection, Driver fatigue caused accidents, Drug effects, Highway characteristics, Driver mental fitness, Davenport

At 2:27 a.m. at the Stockton-New Liberty, Iowa interchange on I-80 a tractor semitrailer ran off the right side of the road, climbed an embankment, and collided with the interchange overpass. The truck driver and an unauthorized passenger were ejected from the cab and killed. Property damage in the amount of —10,000 occurred. The accident was caused by the disorientation of the truckdriver, who was under the influence of amphetamines.  
HS-013 825

**EXHAUST EMISSIONS FROM GASOLINE-POWERED VEHICLES ABOVE 6,000-LB. GROSS VEHICLE WEIGHT. FINAL REPORT**

Southwest Res. Inst., San Antonio, Tex.  
For primary bibliographic entry see Fld. 5F.  
HS-013 899

**5V. Wheel Systems**

**DEFINITION, MEASUREMENT, AND PREDICTION OF MOTOR VEHICLE PERFORMANCE IN EXTREME MANEUVERS: A CHALLENGE TO THE VEHICLE DYNAMICIST**

Michigan Univ., Ann Arbor, Hwy. Safety Res. Inst.  
For primary bibliographic entry see Fld. 5R.  
HS-013 802

**MEASUREMENT AND PREDICTION OF THE DYNAMIC TIRE FORCES OF A PASSENGER VEHICLE ON A HIGHWAY. FINAL REPORT**

Purdue Univ., Lafayette, Ind.  
B. E. Quinn, S. A. Sattaripour 1972 156p 29refs Rept. No. FHWA-RD-72-26, PB-221 120  
Contract DOT-FH-11-7797  
Volume 2 of 'Vehicle Dynamics Studies'.  
NTIS

Tire forces, Tire road contact forces, Pavement surface texture, Tire pavement interface, Tire vibration, Power spectral density, Tire slip motion, Sideslip, Tire inflation pressure, Strain gauges, Histograms, Vibration response, Vibration measurement, Mathematical analysis, Fourier analysis

Vehicle characteristics are determined by operating the vehicle on a pavement having a known pavement roughness spectrum and measuring the dynamic tire forces. If the vehicle is then driven over a second pavement having a pavement roughness spectrum similar to the first pavement, the dynamic tire forces predicted using the vehicle characteristics will agree reasonably well with those measured experimentally. It was determined that the dynamic tire force increases with pavement roughness and also with the vehicle velocity.  
HS-013 832

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**CONTRACTS AWARDED**



## NHTSA CONTRACTS AWARDED

**DOT-HS-204-3-672 Mod. 2**  
**SB3-2-3-8(a)-73-C-448**

### **FARE EVALUATION PROJECT**

Prime: Small Business Administration  
Bala Cynwyd, Pennsylvania 19004  
Sub: J. A. Reyes Associates, Inc.  
1140 Connecticut Avenue, N.W.  
Washington, D.C. 20036

8 Oct 73 to 31 May 74

**\$34,921.00**

This modification provides for the inclusion of two types of outputs to be produced by the FARE Evaluation Project, (1) measures of site FARE effectiveness on a scale of 0 to 1, and (2) descriptive statistics of traffic patterns in the sites. The effectiveness measure provides an indication of the relative success of the FARE program; the descriptive statistics describe the results of FARE and complement the effectiveness measures.

**DOT-HS-4-00815**

### **NEAR-TERM SAFETY IMPROVEMENTS FOR MOTORCYCLES**

AMF Incorporated  
Advanced Systems Laboratory  
495 South Fairview  
P.O. Box 298  
Goleta, California 93017

1 Oct 73 to 1 Oct 74

**\$99,180.00**

Several critical safety areas will be investigated and desirable improvements recommended for incorporation into an experimental safety motorcycle. Injury severity criteria will be defined and selected for motorcycle riders involved in collisions with automobiles, particularly side impacts. Tests will be conducted under various conditions using an instrumented anthropomorphic dummy. Information developed in Phase I on headlamp systems will be reviewed, analyzed, and quantified. Phase I work will be continued to develop standardized tests to determine the strength and reliability of throttle, brake, and clutch control cables.

**DOT-HS-026-2-430 Mod. 3**

### **COMPLIANCE TESTING—WHEELS AND RIMS**

Compliance Testing, Inc.  
1150 North Freedom Street  
Ravenna, Ohio 41266

Delivery of GFE equipment plus 4 months

**\$2,750.00**

This modification provides for additional dynamic radial load fatigue tests of two groups of passenger car wheels to determine the effect of radial ply tires on wheel fatigue life. NHTSA furnishes wheels and tires for the test.

**DOT-HS-017-2-315 IA Mod. 1**

### **"MASS DISTRIBUTION OF A HUMAN SUBJECT"**

6570th AMRL/HEO  
Wright-Patterson Air Force Base, Ohio 45433

30 Nov 73 to 30 Mar 74

**\$40,750.00**

This modification deletes Task III of the original contract and substitutes a requirement to perform specified tests to determine the center of mass and moments of inertia about appropriate axes passing through the center of mass of the cadavers and segments involved in the test.

**DOT-HS-219-3-718 Mod. 1**

### **MULTIDISCIPLINARY ACCIDENT INVESTIGATION**

University of Oklahoma  
Medical Center Research and Development Office  
800 N.E. 15th Street, Suite 500  
Oklahoma City, Oklahoma 73104

3 Jan 74 to 30 Sept 74

**\$9,800.00**

All crashes involving passive and/or crash-recorder-equipped vehicles forming a part of the NHTSA fleet located in a specific area will be investigated, as well as the crashes of any similarly equipped vehicles which may be designated. Preparation will also be made to investigate all school bus accidents in the same specific area which involve three or more fatally injured passengers, or any school bus accident which may be designated.

**DOT-HS-021-3-563 Mod. 2**

**REGION VIII MANAGEMENT INFORMATION SYSTEM**

Safety Management Institute  
1600 L Street, N.W.  
Washington, D.C. 20036

20 Dec 73 to 30 June 74

\$19,906.99

This modification provides for the preparation of certain briefing materials, participation in a 6-month implementation and demonstration of the proposed system to prove its validity and workability, and assistance in expanding the system to the four remaining States of Region VIII.

**DOT-HS-120-3-544 Mod. 7**

**DETERMINE EXPLOSIBILITY LEVEL OF AIR IN VEHICLE TRUNK AREA AND PASSENGER COMPARTMENT**

Essex Corporation  
303 Cameron Street  
Alexandria, Virginia 22314

10 Dec 73 to 25 Dec 73

\$3,576.00

This modification provides for a test to determine the explosibility level of air in the vehicle trunk area and passenger car compartment of a designated vehicle having fuel leaks at both ends of the fuel tank filler hose and at the fuel gauge sending unit. The tests will be conducted under conditions specified by NHTSA, with various phases of the tests photographed in color.

**DOT-HS-4-00807**

**EFFECTS OF MARIHUANA AND ALCOHOL ON THE DRIVER'S VISUAL SEARCH PATTERNS**

Small Business Administration  
849 South Broadway  
Los Angeles, California 90014

28 Nov 73 to 27 Nov 74

\$45,958.00

Research will be performed to develop computer programs for the classification and time history analysis of eye movement patterns during driving. Objectives will include the development of a system for analog-

to-digital conversion of eye point-of-regard data; a calibration technique for relating the eye point of regard to selected features in a motion picture scene; recognition algorithms to determine a variety of specified eye movements; and subroutines to provide various summaries and descriptive statistics from the basic analysis.

**DOT-HS-339-3-652 Mod. 1**

**SCHOOL BUS DRIVER INSTRUCTIONAL PROGRAM**

Applied Science Associates, Inc.  
P.O. Box 158  
Valencia, Pennsylvania 16059

5 Dec 73 to 28 Feb 74

\$3,508.00

This modification provides for the development of new materials and modification of existing materials in Level II Units of the School Bus Driver Instructional Program. Additional illustrations and examples will be created as a part of the modifications.

**DOT-HS-027-3-545 Mod. 3**

**EFFECTS OF CRACKED EXHAUST MANIFOLD ON 1970 DODGE**

General Testing Laboratories  
6840 Industrial Road  
Springfield, Virginia 22151

7 Dec 73 to 1 Feb 74

\$2,949.98

A specific vehicle will be obtained and a number of checks made on the passenger compartment carbon monoxide concentration, exhaust leak noise loudness levels, and engine performance effects resulting from a cracked exhaust manifold.

**DOT-HS-120-3-544 Mod. 8**

**FMVSS NO. 108 TEST STANDS**

Essex Corporation  
303 Cameron Street  
Alexandria, Virginia 22314

12 Dec 73 to 12 Jan 74

\$2,499.00

This modification provides for fabricating, finishing, and inspecting FMVSS No. 108 test stands.

**DOT-HS-025-2-332 Mod. 2**

**LABORATORY PROCEDURES FOR TIRE TESTING AND DATA REPORTING**

Electrical Testing Labs., Inc.  
2 East End Avenue  
New York, N.Y. 10021

No change

No change

This modification provides for changes in test monitoring time (cycles) and adds specific requirements covering instrumentation.

**DOT-HS-4-00834**

**SAFETY RELATED DEFECTS INVESTIGATION: ENGINEERING INVESTIGATION OF INTERNATIONAL HARVESTER COMPANY 1700-1800 SERIES SCHOOL BUS CHASSIS, REAR BRAKE SHOE FAILURES**

North American Testing Company  
1801 Speedway Boulevard  
Post Office Drawer S  
Dartmouth Beach, Florida 32015

18 Dec 73 to 12 Jan 74

\$5,000.00

Test runs will be made with varying combinations of left and right primary and secondary brake shoes removed to determine what effect one or more broken rear brake shoe webs will have on school bus stopping ability, stability, and directional control. Tests will be conducted both empty of passengers and with a simulated passenger load using sandbags.

**DOT-HS-4-00813**

**AUTOMOTIVE RADAR RESEARCH**

Department of Commerce  
Office of Telecommunications  
Institute for Telecommunication Sciences  
Washington, D.C. 20230

12 Dec 73 to 11 Oct 74

\$70,000.00

Research will be initiated to investigate specific areas involving a vehicular radar system to be used in controlling an anticipatory collision avoidance braking device. The areas to be researched include target

signature analysis at 35. and 60. gigahertz; antenna and system investigation to improve target detection and to reduce false alarms; modulation and polarization techniques; development of subsystem requirements for a baseline performance specification; standardized test procedures for evaluating prototype and production systems; and baseline electronic and system logic requirements for signal processing.

**DOT-HS-4-00387**

**FACTORS INFLUENCING A POLICE OFFICER'S DWI ARRESTS**

Dunlap and Associates, Inc.  
One Parkland Drive  
Darien, Connecticut 06820

14 Dec 73 to 14 Oct 74

\$47,092.00

A plan will be developed and initiated incrementally to determine ways to increase the police officer's detection and apprehension rate in driving while intoxicated instances. Selected State and municipal agencies will be visited in areas of various population groupings where interviews will be conducted with appropriate individuals. The frequency of the incident of police discretion in arresting or not arresting for DWI will be determined, as well as the degree of influence of certain identified variables. Based on these findings, ways will be suggested to neutralize or minimize negative variables and to develop and maximize positive variables.

**DOT-HS-4-00821**

**UNIFORM TIRE QUALITY GRADING—TRACTION TESTING**

Transportation Research Center of Ohio  
East Liberty, Ohio 43319

14 Dec 73 to 24 Jan 74

\$29,291.00

Tests will be made to obtain tire traction data in support of rulemaking activities related to Uniform Tire Quality Grading. Twelve bias, twelve belted-bias, and twelve radial tires of various sizes will be quality graded for traction. The two-wheeled test trailer methodology will be used to conduct the tests at various geographical locations to provide surfaces with identical skid numbers of both portland cement concrete and asphaltic concrete.

**DOT-HS-4-00814**

**SEAT BELT ADJUSTMENT CAPABILITY ON 1972  
MERCURY COMET**

Calspan Corporation  
4455 Genesee Street  
Buffalo, New York 14221

14 Dec 73 to 14 Jan 74

\$2,982.00

The adjustment capability of the front outboard position seat belts will be investigated on three Mercury Comets. The tests will be documented on 16-mm film. Support will be provided to the Ford Motor Company for subsequent tests.

**DOT-HS-312-3-598 Mod. 2**

**FATALITY ANALYSIS FILES**

State of Nevada  
Department of Motor Vehicles  
555 Wright Way  
Carson City, Nevada 89701

28 Dec 73 to 31 Dec 74

\$4,034.00

This modification provides for reimbursement for Fatality Analysis Files prepared and delivered to NHTSA after the effective date of this modification.

INVESTIGATION OF  
FATALITY ANALYSIS FILES  
DOT-HS-312-3-598  
MOD. 2

U.S. DEPARTMENT OF TRANSPORTATION  
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